

Report No. UT-02.16

***I-15 CORRIDOR
RECONSTRUCTION
PROJECT
DESIGN/BUILD
EVALUATION
FINAL REPORT***

**By: Stanley S. Postma, P.E.
Roger Cisneros
Et al**

**Carter & Burgess, Inc
Salt Lake City, Utah**

**Utah Department of Transportation
Research Division**

September 2002

UDOT RESEARCH & DEVELOPMENT REPORT ABSTRACT

1. Report No. UT.02.16		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle I-15 Corridor Reconstruction Project Design/Build Evaluation Final Report		5. Report Date September 2002			
		6. Performing Organization Code			
7. Author(s) Stanley Postma, Roger Cisneros, Jim Roberts, Richard Wilkison, Jeff Clevenger, Al Eastwood, and Others		8. Performing Organization Report No.			
9. Performing Organization Name and Address Carter & Burgess, Inc. 420 East South Temple, Suite 345 Salt Lake City, Utah 84111		10. Work Unit No.			
		11. Contract No. 98-8489		98-8489	
12. Sponsoring Agency Name and Address Utah Department of Transportation Research Division 4501 South 2700 West Salt Lake City, Utah		13. Type of Report and Period Covered Final Report, 1998-2002			
		14. Sponsoring Agency Code			
15. Supplementary Notes					
16. Abstract <p>This report is the final report to be produced under a four-year project of evaluation and research into the I-15 design/build project. The Research Division of UDOT commenced this research project as partial fulfillment of the commitments made to the Federal Highway Administration (FHWA) when design/build was permitted for this project. The project was designated as a Special Experimental Project (SEP-14) project. The purpose of the evaluation is to collect and evaluate information derived from the process used in this project and provide this information to other agencies or entities interested in pursuing similar design/build projects in transportation.</p> <p>This report is the final report and summarizes all of the evaluations completed for the project. It includes reports on seven specific areas: selection/award, design, quality assurance/quality control, innovative construction methods, performance specifications, partnering, and public involvement.</p>					
17. Key Words Design-build, contractor selection, interstate construction, QC/QA, design, construction, innovative contracting, partnering, and performance specifications			18. Distribution Statement Available from UDOT Research Division, Box 148410, Salt Lake City, Utah 84114-8410		
19. Security Classification (of this report) N/A	20. Security Classification (of this page) N/A	21. No. of Pages		22. Price	

TABLE OF CONTENTS

EXECUTIVE SUMMARYES-1

Purpose of Report.....	ES-1
Project Background	ES-1
I-15 Expansion.....	ES-1
Summary of Evaluation Results.....	ES-2
Selection & Award Process	ES-2
Design Process	ES-4
Quality Control & Quality Assurance (QC/QA) Program	ES-5
Innovative Construction Methods.....	ES-7
Performance Specifications	ES-10
Partnering Process.....	ES-11
Public Information	ES-11
Conclusions & Recommendations.....	ES-12
Design/Build Methods of Contracting	ES-12
Selection & Award Process	ES-12
Design Process	ES-12
Quality Control/Quality Assurance Process	ES-13
Innovative Construction Methods.....	ES-13
Performance Specifications	ES-13
Partnering Process.....	ES-14
Public Information	ES-14

Chapter One:

SELECTION & AWARD PROCESS.....1-1

Design-Build as UDOT’s Preferred Delivery Method.....	1-1
Comparison of the Design-Build Process to Traditional Contract	1-1
Traditional Contracting Approach	1-1
The Design-Build Process.....	1-1
Reasons to Choose Design-Build.....	1-2
Selection Process	1-2
Risk Factors	1-2
Advantages of Design-Build.....	1-7
Philosophical Shift to Implement Design-Build.....	1-8
Accountability Transfer	1-8
Critical Leadership.....	1-8
“Best Value” Selection	1-8
Use of Stipend.....	1-9
Legislative Authorization.....	1-9
Evaluation Process	1-9
Owner-Provided Information.....	1-14
Performance Specifications	1-14
30% Design Plans	1-14
Final Plans “Sealed Sets”.....	1-14

Geotechnical Information	1-14
RFP on CD-ROM	1-14
Risk Sharing.....	1-15
Insurance	1-15
Disadvantaged Business Enterprise (DBE).....	1-15
Subcontracting Requirements	1-15
Changed Conditions Clause.....	1-15
Performance Bond	1-15
Early-Action Items	1-15
ISO 9000 Certification	1-17
Award Fee	1-17
Lessons Learned	1-18
Commitment Level of DOT Staff	1-18
Use of Stipend.....	1-18
Best Value Selection Method.....	1-18
Confidential Selection Process	1-18
Owner-Provided Information.....	1-18
Geotechnical Information	1-18
Mapping	1-19
Sealed Sets	1-19
Cost Estimates.....	1-19
RFP on CD-ROM	1-19
Risk Sharing.....	1-19
Right-of-Way	1-20
Award Fee.....	1-20

Chapter Two:

DESIGN PROCESS.....2-1

Managing the Design Process	2-1
Staffing Levels (Wasatch).....	2-1
Staffing Levels (UDOT)	2-1
Scheduling	2-4
Project Control Systems.....	2-4
Computer Automation Requirements/Software.....	2-4
Key Procedures.....	2-5
Task Force Meetings.....	2-5
Value Engineering Savings Incentive	2-5
The “Hub”	2-5
Earned Value Reporting.....	2-6
Partnering Program.....	2-6
Design Process.....	2-7
Project Segments and Design Packages	2-7
Reviews.....	2-7
QC/QA Process for Design Phase.....	2-12
Process	2-15
Formal Final Submittal	2-16
Design Change Process.....	2-17

Origination	2-17
Method	2-17
Approval	2-17
Lessons Learned	2-17
Value Engineering	2-17
Development of Standards & Plans	2-18
Performance vs. Prescriptive Specifications	2-18
Constructability Reviews	2-19
Engineer of Record	2-19
Accelerated Construction Schedules.....	2-19
Consolidated Office Location – “Hub”	2-19
Advantage of Task Force Meetings	2-19
Audits	2-19
Reviews.....	2-20
Impacts of Time-Driven Schedules	2-20
Owner Involvement	2-20
Over-the-Shoulder Reviews	2-20

Chapter Three:

QUALITY ASSURANCE/QUALITY CONTROL (QC/QA) PROGRAM.....3-1

The I-15 QC/QA Process.....	3-1
Design QC/QA – Wasatch	3-2
Roles and Responsibilities in the DQMP.....	3-2
Design QC/QA – UDOT.....	3-6
Technical Support	3-6
Construction QC/QA	3-9
Quality Assurance Roles and Responsibilities.....	3-9
Quality Assurance Process.....	3-13
Quality Control Roles and Responsibilities	3-13
Wasatch Testing Laboratory	3-15
Construction Oversight – UDOT	3-15
Construction QA – ASTER	3-16
Changes to QC/QA Organization	3-16
Acceptance Testing Reassigned to QC	3-16
Pavements QC Group	3-17
Changes to Staffing Level.....	3-17
Partnering As Part of QC/QA	3-17
Memorandum of Understanding (MOU) and the Technical Agreement	3-17
Data Coordination & Security	3-18
Acceptance Testing.....	3-18
Conflict of Interest	3-19
Cultural Challenges.....	3-19
Quality Control	3-19
Quality Assurance.....	3-19
Job Security.....	3-20
Lessons Learned	3-20
Field Review Process	3-20

Laboratory Certification.....	3-20
Quality Management Plans	3-20
Personnel Certification.....	3-20
Quality Assurance Role	3-20
Field Procedures Manual	3-21
Magnitude of QC Program.....	3-21

Chapter Four:

INNOVATIVE CONSTRUCTION METHODS USED ON THE I-15 PROJECT.....4-1

Settlement Issues.....	4-1
Lime Cement Columns	4-2
Stone Columns	4-2
Wick Drains	4-3
Embankment Fills	4-3
Post-tensioned Concrete Decks.....	4-10
Pre-Cast Concrete Spliced Girders (Nebraska Girders).....	4-10
Pre-Cast Deck Panels.....	4-11
Moment Slabs	4-12
Jumbo Slabs (Bridge Approach Slabs)	4-14
Seismic Design Criteria	4-16
Design Life and Performance Criteria	4-17
Pavement Performance Life.....	4-18
Structure Performance Life.....	4-18
Lessons Learned	4-18
Settlement Issues.....	4-17
Lime Cement Columns	4-18
Geofoam Embankments.....	4-18
MSE Walls.....	4-19
Post-Tensioned Concrete Decks	4-19
Pre-Cast Concrete Spliced Girders	4-19
Pre-Cast, Stay-in-Place Deck Form	4-19
Spliced Girder Bridges.....	4-19
Moment Slabs	4-19
Seismic Criteria.....	4-19

Chapter Five:

PERFORMANCE SPECIFICATIONS5-1

Types of Specifications.....	5-1
TRB Specifications Categories	5-1
Development of Specifications.....	5-2
Process	5-2
Risk	5-2
Design Life	5-2
Changes Requested By the Proposer	5-3
Including QC/QA Roles in Specifications.....	5-3
Task Force Meetings.....	5-3

I-15 Specifications Categories	5-3
Performance Specifications	5-4
Hybrid Specifications.....	5-5
Prescriptive Specifications.....	5-6
Use In Design	5-7
Geofoam.....	5-8
Traffic Signals.....	5-8
Structure Specifications	5-8
Use In Construction.....	5-8
Memorandum of Understanding and Technical Agreement.....	5-9
Lessons Learned	5-9

Chapter Six:

PARTNERING PROCESS6-1

Partnering Definition	6-1
Commitment Prior to RFP Release	6-1
Partnering Organization.....	6-1
Facilitator.....	6-2
First Partnering Session	6-2
UPRR Partnering Session	6-2
Partnering Process	6-4
Charters at Each level	6-4
Escalation ladder.....	6-4
Facilitator Role	6-4
Regular Evaluations.....	6-6
Evaluation Meetings Frequency	6-6
Nurturing Relationships	6-6
Reaffirmation.....	6-6
Partnering Challenges and Solutions.....	6-20
Diverse Cultures	6-20
Memorandum of Understanding for “Better or Equal Substitutions”	6-20
Issues Needing Outside Experts.....	6-20
Adhering to Escalation Time Limit Procedures.....	6-22
Award Fee.....	6-22
Lessons Learned	6-22
Commitment to Partnering.....	6-22
Internal Partnering Meetings.....	6-22
Designer Involvement in Board of Directors (BOD).....	6-23
Escalation Time Limits	6-23
Need to Follow the Escalation process	6-23
Need to Provide Rationale for Decisions Made at Higher Levels	6-23
Partnering Empowerment	6-23
Principle of “Doing the Right Thing”	6-23
Frequent Reviews of Charter on Long-Term Projects	6-23
Importance of Formalizing the Process	6-23
Emphasizing Professional Interactions	6-24

Chapter Seven:	
PUBLIC INFORMATION.....	7-1
Objectives and Goals.....	7-1
Roles and Staffing.....	7-1
Techniques	7-2
Traditional Techniques	7-2
Non-Traditional Techniques	7-4
What Worked	7-5
Key Successful Components.....	7-6
What Didn't Work	7-7
Key Problem Areas.....	7-7
Lessons Learned	7-8
Conclusion	7-10

TABLE OF FIGURES

Figure 1-1.	Risk/Responsibility Allocation Chart ‘A’	1-3
Figure 1-2.	Risk/Responsibility Allocation Chart ‘B’	1-4
Figure 1-3.	Risk/Responsibility Allocation Chart ‘C’	1-5
Figure 1-4.	Risk Chart.....	1-6
Figure 1-5.	Evaluation and Selection Organizational Chart	1-11
Figure 1-6.	Flow Diagram for Evaluation and Selection Process	1-12
Figure 2-1.	UDOT I-15 Management Team	2-2
Figure 2-2.	Wasatch Constructors Project Management.....	2-3
Figure 2-3.	Full Design Process – Sheet 1	2-9
Figure 2-4.	Full Design Process – Sheet 2	2-10
Figure 2-5.	Full Design Process – Bridge Design – Sheet 3	2-11
Figure 2-6.	Number of Oversight Reviews Performed	2-14
Figure 2-7.	Design Quality Audits	2-14
Figure 3-1.	UDOT I-15 Management Team	3-3
Figure 3-2.	UDOT I-15 Management Team (cont.).....	3-4
Figure 3-3.	I-15 Reconstruction UDOT Project Organization.....	3-6
Figure 3-4.	UDOT Technical Support	3-7
Figure 3-5.	UDOT Construction & Quality Oversight	3-8
Figure 3-6.	Wasatch Constructors Flow Chart for Field/Design Modifications	3-10
Figure 3-7.	Wasatch Constructors Flow Chart for Field/Design Modifications (cont.).....	3-11
Figure 3-8.	Wasatch Constructors Quality Assurance Organization	3-12
Figure 3-9.	Wasatch Constructors Quality Control Organization.....	3-14
Figure 4-1.	Geofoam Construction Method.....	4-7
Figure 4-2.	Two-Staged Wall Design	4-8
Figure 4-3.	Beam Cross Sections	4-11
Figure 4-4.	Moment Slab Typical Applications.....	4-13
Figure 4-5.	Drilled Caissons Detail.....	4-14
Figure 4-6.	Approach Slab (Jumbo Slab).....	4-15
Figure 4-7.	Mud Jack Details	4-15
Figure 6-1.	I-15 Reconstruction Project Partnering Charter	6-3
Figure 6-2.	Segment-Level Charter.....	6-5
Figure 6-3.	Memorandum of Understanding	6-20

EXECUTIVE SUMMARY

Purpose of Report

On April 15, 1996, the Utah Department of Transportation (UDOT) requested approval from the Federal Highway Administration (FHWA) to use the design-build process for the I-15 Corridor Reconstruction Project (I-15 Project). Because design-build was not considered a standard delivery method at that time, FHWA granted approval to UDOT under the provisions of FHWA Special Experimental Project 14 (SEP-14). As a stipulation for approval to use design-build process, UDOT was required to prepare reports documenting their experience so that other agencies could learn from it and make better decisions on project delivery methods for future projects.

UDOT contracted with a private consultant, Carter & Burgess, Inc., of Salt Lake City, to prepare a series of reports documenting several aspects of the project. Four consecutive annual reports were prepared in 1998, 1999, 2000, and 2001 and are available from the UDOT Research Division.

This report is a summary report of subjects contained in the four annual reports and the overall design-build process used for the I-15 Project. It contains a summary of the subjects discussed in the annual reports and summaries of the lessons learned.

In addition to the reports prepared for the I-15 Project, UDOT is conducting several other research projects associated with the reconstruction of I-15. These additional reports address technical issues of the project and some monitor long-term performance of construction methods employed in the project. The reader is referred to the UDOT Research Division for more details on the scope and extent of these other research efforts.

Project Background

The I-15 freeway in the Salt Lake Valley was essentially completed in the early 1960s. By 1980, considerable congestion had begun to cause significant operational and performance problems. Thirty years of increasing traffic loads and the use of de-icing salts had resulted in severe deterioration of most of the bridges and elevated structures. Additionally, none of the existing structures had been designed to meet current seismic design standards. The increased traffic volumes also resulted in capacity problems with the existing system.

To meet increasing traffic demands, the Wasatch Front Regional Council (WFRC), the Metropolitan Planning Organization (MPO), and Utah Transit Authority (UTA) concurrently considered options to expand highway and transit service within the Salt Lake Valley. Consequently, the decision was made to prepare a joint highway and transit needs and environmental study of the corridor. It was determined that I-15 needed to be reconstructed and additional capacity added to keep pace with the considerable growth that had occurred in the Salt Lake Valley and along the corridor in other parts of Utah. The need for a fixed rail transit system (light rail) to serve the corridor was also identified.

I-15 Expansion

UDOT began developing a program for the expansion and upgrade of I-15 about 1990. The consulting firm of Parsons, Brinkerhoff, Quade and Douglas (PBQ&D) was hired to begin development and

planning of a traditional design-bid-build project to replace approximately 26 km (17 miles) of urban interstate highway, including some 130 structures, 8 urban interchanges, and 3 major freeway-to-freeway junctions (I-15 connections with I-80 and I-215). Availability of funding for the construction necessitated dividing the project into approximately 20 segments to be constructed in phases over an 8- to 10-year period.

The results of the Governor's Growth Summit in December 1995 and findings from UDOT public opinion surveys, focused on the I-15 corridor and the need to complete the reconstruction in a timelier manner. Six months earlier, Salt Lake City had been awarded the 2002 Winter Olympic Games. After an investigation of possible alternatives to expedite the construction of the project, UDOT decided in January 1996 to use design-build as the contracting method to complete the reconstruction. The legislature passed enabling legislation permitting the use of design/build on a limited basis for state projects during the 1996 legislative session. Prior to that legislation this method was not permitted. Subsequently, in February 1997 the Utah State Legislature established the Centennial Highway Fund to address the un-funded transportation needs across the state. The I-15 reconstruction project was a centerpiece of that plan. A major objective was to complete the I-15 reconstruction in a shorter time period to reduce travel impacts prior to the start of the Olympic Games.

On April 15, 1996, the Utah Department of Transportation (UDOT) requested approval from the Federal Highway Administration (FHWA) to use design-build for the I-15 Corridor Reconstruction Project under the provisions of Special Experimental Project 14 (SEP 14). April 15, 1997, UDOT issued a Notice to Proceed (NTP) to Wasatch Constructors (Wasatch) to design and construct the project and held a ground breaking ceremony. Wasatch's design-build proposal was \$1.352 billion for the base price plus construction and maintenance options, making it the largest single highway contract (traditional or design-build) in the United States at the time of award.

Summary of Evaluation Results

The following sections present a summary of the topics covered in each chapter of this report.

Selection/Award Process

Preliminary Work. In February 1996, UDOT contracted with PBQ&D to assist in developing a Request for Proposal (RFP) for services of a design-build entity to complete the reconstruction project. Concurrent with the RFP development, UDOT awarded several contracts (more than ten) to consulting engineering firms to prepare portions of a preliminary design of the project for use in the RFP. UDOT also contracted with several geotechnical engineering firms to conduct an extensive geotechnical investigation program of the corridor to provide foundation information that would be included in the RFP. UDOT staff also developed plans for suitable detour routes using existing parallel streets and expanding their capacity by adding additional lanes, improving intersections and traffic signals, and other improvements.

Statements of Qualifications. In March 1996, a request for a Letter of Interest (LOI) was advertised internationally to identify potential entities interested in proposing on the project. Information meetings were held in May 1996, to brief interested firms on the project scope. On May 30, 1996, a formal request for Statements of Qualifications (SOQ) was issued with information about the project scope, instructions to potential bidders on the content and format of the SOQ, and the criteria UDOT would use to evaluate the submittals. The submittals were due July 1, 1996, with expectations that as many as five groups would respond to the request.

This process was used by UDOT to screen potential firms with the intent to limit the number of potential bidders to no more than five firms. A qualification evaluation board was established to evaluate the submittals and determine which were qualified to propose on the project. Three SOQs were received and each was judged qualified to proceed to the proposal stage.

Selection Process. UDOT was concerned about awarding the I-15 Project based solely on low bids, since the proposers would not have detailed, complete plans to prepare the bids. UDOT further wanted to encourage all proposers to submit innovative ideas for both design and construction that could be considered by the evaluation team in the overall evaluation process, and that subsequently could be used by the successful design-build contractor.

To achieve these objectives, UDOT developed a process they termed “best value selection” that resulted in selection of the firm that made the proposal considered the “best” value to the state of Utah. Proposal evaluation criteria and a process were created to ensure the technical and cost proposals were evaluated separately. Ultimately, a small, select group of individuals had knowledge of both the cost and technical evaluation results, and this group made the final selection of the contractor.

To enable UDOT to award on a design-build and “best value” basis, special legislative authorization was enacted. The authorization permitted UDOT to award on any one of the following conditions:

- Award to the responsible proposer offering the lowest-priced responsive proposal. If the RFP includes a mandatory technical level, no proposal shall be considered responsive unless it meets that level.
- Award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.
- If the RFP provides for a stipulated sum, award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.

Request For Proposal. On August 1, 1996, UDOT issued a draft Request for Proposal (RFP) to each of the three pre-qualified firms, requesting each to review the draft RFP and respond to UDOT with any comments, concerns or suggestions they had about the RFP. UDOT also held face-to-face discussions with each group. UDOT modified the RFP and issued it in final form on October 1, 1996. Proposals were due January 15, 1997. Additional intermediate dates were established for:

- Submission of comments or requests for clarifications of the RFP
- Submission of technical concepts and requests for exceptions and deviations from the RFP
- Submission of an Air Quality Emission Control Plan
- Target dates for addenda to the RFP initiated by UDOT

The RFP contained provisions for a Best and Final Offer (BAFO) processes that UDOT could invoke, at their option (which was subsequently done). BAFOs were submitted to UDOT on March 7, 1997.

Award. An award of the contract was announced on March 26, 1997, to a consortium of firms named Wasatch Constructors, led by Kiewit Pacific, Granite Construction and Washington Construction. The team included a number of engineering design firms led by Sverdrup Civil and DeLeuw, Cather and Company. The award was made on the basis of “best value” determination and Wasatch was judged to have an “Exceptional” technical evaluation. The amount of the awarded contract was \$1.325 billion,

which included the base bid and several construction options—making it the largest single highway contract (traditional or design-build) in the country at that time.

Design Process

Management. Wasatch contracted with an engineering consulting firm to provide the design services required by the I-15 Project. A joint venture of Sverdrup Civil, Inc. (now Jacobs Engineering) and DeLeuw Cather (now Parsons Transportation Group) and called Sverdrup/DeLeuw was formed to provide these services. They, in turn, subcontracted with approximately 20 other firms to provide portions of the design services.

In order to coordinate and control the work, Wasatch chose to establish a project office and locate all of the design and construction staff in the same building. UDOT also chose to relocate their project team to the same office building. The consolidated office became known as the “Hub.” The Contractor, designers, and UDOT shared a common computer network system, with separate secure locations for each party, and phone system to facilitate the exchange of information electronically. This common location was viewed as a major success for the project and was enthusiastically recommended by all parties for future similar project.

UDOT had a staff of approximately 60 people to manage and review the design process and provide construction management activities associated with the project. Wasatch had more than 350 engineering and design staff located at the “Hub” during the peak design period. Additional off-site staff was also used during a portion of the design process when Wasatch decided to accelerate the design process. The off-site staff consisted mostly of bridge design engineers because it was felt this type of work was more exportable than other design elements. The design was completed in approximately eighteen months.

Wasatch developed more than 350 standard drawings for use in design and construction. The original intent was to use UDOT standard drawings; however, after review, Wasatch chose to develop a set of standards that corresponded more directly to the I-15 Project. This did not occur until after the design process already was underway.

Reviews. A process known as “over the shoulder” review was adopted by UDOT to perform reviews and interact with Wasatch. This process was intended to take the place of more formal reviews that are more typical of DOT projects. A final, formal submittal was required by the contract upon completion of the design, but UDOT did not conduct formal, detailed reviews at other times.

In place of the traditional review process, UDOT met regularly with the design and contractor team as the design advanced to provide input concurrent with design development. Task Forces for major elements of the design were established to accomplish this. These groups met weekly and discussed and reviewed designs that were under consideration. The majority of the feedback was gathered in these Task Force meetings. In addition, because all parties were located at the “HUB,” there were regular opportunities for less formal discussions during the design process. Minutes of the Task Force meetings were kept to track issues and decisions and were used to assure final resolution on design issues.

At the conclusion of design, a formal submittal of 13 design packages was made to UDOT for final acceptance. Only a one-week review period was provided for each package so submittals were staggered over a 13-week period. This turned out to be satisfactory since UDOT had essentially seen all of the

design as it was developed and had provided input earlier in the process. More than 14,000 drawings and thousands of pages of specifications and calculations were submitted at completion of the design phase.

Key Procedures. To expedite the construction schedule, Wasatch used a process that allowed partially completed design plans and specifications to be released for construction. This permitted construction to start concurrently with completion of final design. Once a drawing or specification was developed sufficiently to start parts of the construction, it was reviewed by Wasatch and released for construction. As additional design was completed, the drawings were modified to show the changes and additions and released again. Sometimes this was done several times with the same plan as the construction progressed. UDOT conducted “over the shoulder” reviews for these plans, and Wasatch accepted liability for any changes required by the more complete plans. Final acceptance/approval of the plans did not occur until the end of the project.

UDOT performed a value engineering analysis of the conceptual plans in the process of developing the RFP for the project. Additionally, a traditional value engineering process was made a part of the contract and incentives were identified if the process resulted in benefits to UDOT.

The formal value engineering process was seldom used in the contract. The contract was a lump sum contract so the opportunity to provide a savings to the Owner is minimized. Meeting the schedule was also such an overriding objective that oftentimes it was considered more important by the Contractor to complete the project on time than consider an option that could result in a savings to the Owner.

The traditional value engineering process does not lend itself very well to Design/Build. By its nature design/build contracts provide flexibility to the contractor to make improvements in the design or changes that reduce the cost to the Contractor within the lump sum bid format. Therefore there is less incentive to save the owner costs normally associated with a more traditional contract form. The focus of the Contractor team is on ways to save time and costs in executing the work called for under the lump sum contract while still meeting the contractual requirements.

Partnering was used extensively during the design process and was instrumental in the successful completion of the design. The “over the shoulder” process and centralizing the staff in one location aided in the partnering process. Regular partnering meetings were held where issues affecting the design and review processes were discussed and conflicts resolved. Both parties indicated that partnering was essential in this process and the design could not have been completed on the schedule without this commitment.

Quality Control and Quality Assurance (QC/QA) Program

Wasatch was required by contract to develop a Quality Management Plan and a QC/QA Plan for Design, Construction and Maintenance that could be certified using the ANCI/ASQC Q90001 (ISO 9000), an internationally recognized certification process. This was a significant departure for UDOT from their normal procedures where UDOT normally performed this role. Wasatch completed and obtained certification for the Quality Management Plan, the Design Quality Management Plan, and the Construction Quality Management Plan. The Maintenance Quality Management Plan was required only if UDOT elected to have maintenance provided by the Contractor. UDOT elected not to award this portion of the work, so the Maintenance Quality Management Plan was never prepared.

Assigning the QC and QA roles to the Contractor was a significant cultural change for both Wasatch and UDOT. Neither party was accustomed to these roles, and it required adjustments on both sides to make this function well. Within a relatively short period of time UDOT gained a high confidence level in the QC role Wasatch provided in the materials testing areas. The confidence level in other project areas was slower in developing and appeared to be constrained by historic cultural differences.

Wasatch Role. Wasatch provided QC and QA staff to implement the program. Portions of this staff came from the design team and the rest from the contractor's staff. During the design phase Wasatch's design team provided all of the QC and QA review, and UDOT provided oversight.

Initially, Wasatch assigned the majority of staff to the QA role because it was thought acceptance testing would fall under that function. Subsequently, it became apparent that most of the testing was required in the QC phase, and Wasatch transferred staff to the QC role. Once this occurred, there were approximately 10 to 15 people assigned to QA roles and approximately 50 to the QC role.

Throughout the project there was a shortage of qualified construction inspectors available from the local labor pool, probably because this was traditionally provided by UDOT. UDOT required certification of the inspectors at a Level IV NICET, but later relaxed this to a Level II when sufficient certified personnel could not be found. This seemed to help with staffing.

Wasatch elected to establish a materials testing laboratory to perform most of the required material testing functions. The contract required the lab to be certified by AASHTO. It took almost one year to obtain all necessary certifications of the lab. During the certification process, UDOT and others performed the testing. Once the lab was certified, Wasatch assumed control over the QC process.

UDOT Role. Both UDOT and the Contractor agreed to divide the project into segments for management purposes. Initially there were three geographic segments and one representing the ATMS work. This was later expanded to include a corridor-wide pavement segment also. UDOT provided oversight with a small team of about 6 to 10 engineers and inspectors assigned to each segment. FHWA also assigned at least one person to each segment team. This staff provided oversight in the field and reviewed Contractor-submitted reports. Much of the oversight included a detailed statistical analysis of QC reports. This was monitored very closely and served as a key oversight tool by UDOT.

In addition, UDOT hired an independent firm (ATSER) to provide verification testing of the Contractor's work. Typically, the goal was to sample and test 10 percent of the Contractor's test to confirm the results. Monthly reports were prepared and used by UDOT to monitor the work and determine its acceptability. In addition, UDOT used their own laboratory to conduct corollary tests on the Contractor's equipment and methods. UDOT also assisted in certifying the equipment and technicians used by Wasatch in testing.

Change Process. To handle and track change orders during construction, Wasatch developed an extensive process. Issues requiring design changes were referred back to the "Hub" for approval by a small group of engineers maintained on staff to provide construction support. UDOT was involved in and kept records of all changes.

Difficulties arose during construction of the portions of the project for which UDOT had provided sealed, completed plans to the Contractor in the design-build RFP. A Memorandum of Understanding (MOU)

was created to handle these changes which included changed site conditions, modification of UDOT Standard Specifications and streamlining the process for modifying any work. The MOU provided Wasatch the opportunity to substitute without processing a change order or a claim. As long as UDOT considered the change “equal to or better” to the design in the original contract, a simple, no-cost change was made and documented. Over the life of the contract, more than 1,000 of such substitutions were agreed to. This agreement contributed to the situation that there were no outstanding monetary issues remaining to be resolved at the conclusion of the project.

Innovative Construction Methods

Several construction methods were used on the I-15 Project that UDOT had not considered previously for use in Utah, although they had been used in highway construction elsewhere in the United States. Three annual reports prepared over the course of the project described the use of these methods and evaluated the success of each.

Most of the new methods addressed the difficult soil conditions along the I-15 Project corridor that exhibit high settlement potential. Several methods were used to accelerate, reduce, or eliminate settlement, such as lime cement columns, stone columns, wick drains, mechanically stabilized earth (MSE) walls, and Geofoam and lightweight fill.

There were several structural innovations used on the project. These included the use of pre-cast pre-stressed concrete girders spliced together, transversely post-tensioned concrete decks, stay-in-place pre-stressed concrete deck panels, jumbo slabs, and moment slabs

Also unique were the seismic design criteria. The Salt Lake Valley lies within a seismically active zone making the design parameters for the seismic design of structures and walls an important issue. Wasatch chose to replace AASHTO criteria with a combination of seismic criteria, based on the California methods (ATC-32) developed after the Loma Prieta earthquake and AASHTO criteria.

The requirements for design life of the structures and pavement were unique to the I-15 Project. The design-build contract required a design life of 75 years for structures and 40 years for the concrete pavement.

Lime Cement Columns. Lime cement columns were proposed by Wasatch to stabilize the foundation in many areas. It is similar to the stone column, except instead of placing stones in the column, lime and cement are added to the native soils and mixed to increase their strength. Wasatch ultimately used this very little because it proved to be more expensive and slower to perform than expected. Wick drains became the preferred stabilization method in most cases.

Stone Columns. Stone columns were used to stabilize the foundation and increase the bearing capacities, specifically to mitigate liquefaction-induced settlement in case of a seismic event. They are formed by auguring into the foundation and placing pea gravel sized stones in a column. By placing a pattern of these columns under a foundation, settlement is reduced or eliminated. Because of its relatively high cost, this technique was used sparingly on the project and most frequently near the Jordan River for bridge abutments.

Wick Drains. Wick drains were used extensively to provide drainage into the clay layers of the foundation so that hydrostatic pressure could be quickly relieved when the foundation was surcharged to induce settlement at an accelerated rate.

When the freeway was first constructed, fills were surcharged for several years before construction could continue. Wick drains shortened this process to 18 months or less and proved an essential element to meeting the four-year construction schedule.

Mechanically Stabilized Earth Walls (MSE). Wasatch made extensive use of MSE walls. Virtually the entire length of the I-15 Project was constructed on fill sections, and sliver fills were added to the existing fill section to provide the additional width required by the new lanes added to the freeway. The advantage of the MSE wall was the flexibility it afforded, given the expected amount of settlement under embankments and fills.

Two types of MSE walls were used: single-stage and two-stage. The difference between the two types of walls is in the way the facing panel is connected to the internal wall system. A single-stage wall was constructed using traditional MSE wall methods with the facing panels being erected concurrent with the wall construction. The single-staged wall was constructed in areas where settlement was expected to be minimal or where it would occur during the construction process.

The two-staged wall was constructed in stages with the embankment placed first and typically surcharged to induce settlement. The walls were then allowed to settle until the expected level of settlement was achieved. The surcharge was then removed and concrete-facing panels attached to the outside face. The panels were hinged at the connection point to allow additional minor settlement to occur without displacing the facing panels. This method was used extensively in the northern portion of the project where foundation soils were very soft and settlement of up to 2 meters was experienced.

Both systems worked very well. There were only a few problems encountered with the two-staged walls. In one location with about two meters of settlement, adjacent structures located very near the walls also began to settle and Wasatch had to perform some remedial measures to repair damage to foundations. Another concern appeared in the initial uses of the two-staged walls where slumping occurred along the face of the wall during surcharging. Some of this occurred near the base, while in other locations it appeared higher up in the wall. Minor modifications were made to the gradation specification for the fill material used against the face and the compaction procedures. This seemed to remedy the problems.

Geofoam and Light Weight Fill. Wasatch utilized Geofoam polystyrene foam blocks in place of earth fill in locations where wick drains would not accelerate settlement fast enough or where it was too expensive to relocate features that would have been impacted by settlement. Geofoam decreased the weight of the fill to approximately 10 percent of the weight of earth fills.

Wasatch developed several details for constructing embankments with Geofoam cores. Because Geofoam is susceptible to degradation if exposed to sunlight or hydrocarbon compounds, special construction methods were used to protect the foam blocks.

The use of foam blocks proved to be very successful. There were several embankments and walls constructed up to 10 meters in height using this method. The only unexpected development was how much the foam blocks settled. Designers had expected no settlement within the blocks, but actual

measurements indicated several millimeters of settlement within the foam blocks. It was thought this was due to shifting of the blocks during placement. UDOT is conducting a long-term research project to monitor the performance of the Geofoam walls that will be available for future reference.

In addition to Geofoam, lightweight fill materials, such as scoria (a volcanic material) and slag from steel mills, were frequently used adjacent to bridge abutments. Each of the two methods substituted this material for granular fill, which typically reduced the weight of the fill by about 20 to 30 percent.

Bridge Structures. UDOT expected to gain the benefit of several innovated methods for structure types by using the design-build delivery method. However, this was not completely realized because Wasatch chose to save time in both approval and construction by using mostly conventional structure types.

Examples of methods not previously used by UDOT include:

- Spliced concrete girders to achieve spans approximating 100 meters (300 feet) using pre-stressed concrete beams. The splices were made using a modified Nebraska type bulb tee girder and then splicing them together with post-tensioned cables. Three members were used in the typical girder span.
- Transversely post-tensioned concrete decks on the steel girder bridges to increase the spacing between girders, thus reducing the number of girders required. Using this method, some of these decks had cracks show up transverse to the span after they were placed and open to traffic. Subsequently, these decks were sealed with a surface sealer to protect them from de-icing salts. Micro silica fume was added to the deck concrete mix to increase the density of the concrete and reduce the potential for de-icing salt penetration into the concrete. Wasatch also changed the placement practice and cast all decks during nighttime hours when cooler temperatures helped reduce premature setting of the concrete after the first year of construction.
- Pre-cast pre-stressed concrete deck panels designed to stay in place with construction. UDOT had previously used metal panels but they had not used the concrete panels that were cast integral with the deck concrete. UDOT was concerned about the long-term performance of these panels, given the practice of using salts to de-ice the roads in Utah. Some of the panels did have cracks in them; however, it appears these panels are performing satisfactorily.
- Jumbo slabs used for bridge approach slabs where post-construction settlement could occur. The very thick approach slab was designed to be jacked if settlement resulted in uneven pavement at the bridge approach. The slab was designed as a beam structure and tubing was installed in the slab so that grout could be injected to raise the slab as needed. Typically the slabs were longer in length than normal approach slab designs.

Moment Slabs. Much of the widening of the freeway was done by constructing small “sliver” fills along the edges of the existing fills slopes using MSE walls. To accommodate this method, the designers developed “moment slabs” to reduce the load near the outside edge of the pavement carried by the embankment. The moment slabs transferred some of the traffic load and impact loads on outside edge barriers to the pavement section further inside. The outer edge pavement slab was reinforced and

thickened to transfer some of the load back into the interior pavement section. In some cases, a caisson shaft was designed to support this load and transfer it lower into the embankment section.

Performance Specifications

When UDOT made the decision to use design-build as the contracting vehicle for the I-15 Project, they decided to implement performance oriented specifications as much as possible. Their justification was that performance specifications would:

- Provide flexibility to the Contractor to propose new methods and ideas for the design and construction of the project
- Provide flexibility to the Contractor to meet the time, cost, and quality constraints of the project.
- Assign appropriate responsibility and risk to the Contractor for design and construction means and methods.
- Allow the Contractor to optimize his resources for the project and better match with his capabilities, and let the designers design to the strengths of the Contractor.

A benefit to utilizing design-build was that it allowed the Contractor to be innovative and creative and to maximize the team's strengths. UDOT felt that by emphasizing this flexibility in the performance specification, the Contractor would have a greater sense of ownership, which in turn would lead to better quality.

Specifications Development. A pure performance specification covers specific performance criteria and measurement standards. This is difficult in highway construction because, in many cases, the appropriate time to measure performance is several years after construction is completed. Examples of this are settlement of structures and fill and smoothness of pavement after several years of use. It demands that the writer anticipate many years into the future to establish appropriate performance and measurement criteria.

There is limited industry experience with performance specifications, which created challenges for the I-15 Project. Typically, performance specifications were used by UDOT to establish the standard or the performance level of the constructed facility. Wasatch used these specifications to develop design and write the prescriptive specifications that were given to the construction personnel.

The MOU agreed to by Wasatch and UDOT covering "equal or better" played a part in interpreting the performance specifications to create more prescriptive construction specifications. Once the MOU was in place, Wasatch had considerable flexibility to use more innovative solutions to meet the intent of the performance specifications and project objectives.

It was felt that performance specifications allowed Wasatch to implement several of the innovative methods and ideas discussed in the previous section. This was particularly evident in the several methods used in embankment fill and retaining wall construction.

UDOT and the Project Team developed three types of specifications: UDOT standard prescriptive specifications; performance specifications; and a hybrid between the two with elements of prescriptive and performance. Of the eighteen project specifications evaluated by a review team, eight were

considered to be performance specifications, seven were a hybrid combination, and three were prescriptive.

Partnering Process

UDOT encouraged the use of partnering from the very beginning of the project. The specifications offered the opportunity and the Contractor chose to use partnering processes on the project. Both UDOT and Wasatch worked very hard to develop a partnering relationship among the various project teams. This included partnering processes at several management levels, from Executive Director/Contractor to the field segment levels.

The purpose of the partnering process was to provide an avenue of resolution for conflicts at the lowest possible level in the project, as well as to foster a team concept between the Owner and Contractor that would achieve some synergistic benefits. UDOT strongly encouraged a facilitated partnering process. A full-time facilitator was actively involved in keeping the partnering process active through the entire term of the project. Regularly scheduled, facilitated partnering meetings were held at all levels. The partnering teams were monitored to assure that issues were being considered and resolved according to the partnering process.

To further encourage a partnership attitude on the project the name “I-15 Team” was coined and used by all parties when communicating to the general public. Regular evaluations of the process were made and reports provided to the top-level management of each organization. UDOT top management also provided considerable support to the principals of partnering, oftentimes personally encouraging team members in the partnering concepts.

Each party to the contract expressed high praise for the partnering results achieved on the project. Both UDOT and Wasatch indicated that partnering played the key role in completion of the project ahead of schedule and under the budget. They each became strong advocates of this process and recommended that similar processes be used on other projects.

Public Information

UDOT made a critical decision to hire a public relations consultant (Wilkinson Ferrari) to implement and oversee the public information program for the I-15 Project. Wasatch was required to provide public involvement staff who worked with UDOT and the consultant to implement the public involvement activities. The internal goals of the public information program were inform the public of the progress, provide “coping” information for users inconvenienced by the construction and to educate the public about the I-15 Project process and maintain support for the reconstruction project. Through this trust, the I-15 Project could be completed more smoothly and efficiently. Public confidence and buy-in allowed UDOT and Wasatch to do their job more effectively and efficiently because the public came to trust UDOT to do a quality job.

The principal objectives of the public information program were to:

- Educate the public on the I-15 Project’s vision.
- Inform the public on project progress.
- Provide information to assist the general public in coping with the inconveniences resulting from the project during its construction.

UDOT and Wasatch divided responsibilities into vision and progress information (UDOT) and coping information (Wasatch). This structure and the division of work between UDOT and the Wasatch public information staffs proved to be very effective.

Several key elements were used in the public information programs, including:

- Interest and involvement of ‘top-level’ staff at UDOT and Wasatch with the mayors and state legislators.
- Unique public information team structure in which clearly assigned roles and responsibilities in communicating with the public were defined.
- Use of research to identify public issues and shape timely agency response.
- Extensive use of the media in ‘getting the word out’.
- Delivery on commitments.

CONCLUSIONS AND RECOMMENDATIONS

This section is a summary of conclusions and recommendations of the evaluation of the I-15 Design/Build project. More detailed discussions of the lessons learned and details of the project are included in the chapters of the report.

Design/Build Methods of Contracting

UDOT concluded that this method of contracting for construction was appropriate for this project. The method enabled UDOT to achieve their objectives of completing the project in an accelerated time frame, at a fixed price and with acceptable quality. Each of these objectives was fully accomplished in this project. The project was completed under budget and ahead of schedule.

Selection and Award Process

UDOT developed a concept of “best value” selection which was used on this project. This permitted UDOT to select a contractor based upon the evaluation of the best value to UDOT and not necessarily the lowest priced bidders, as traditionally done by DOT’s.

1. Best Value permits selection on qualifications and innovations instead of just least cost.
2. Establishing RFP and Selection criteria requires a considerable up front investment by the Owner to properly establish this method. The investment comes in both money and staff time commitments to thoroughly develop the process.
3. An evaluation, assessment, and assignment of risks of the project and the contracting method are essential to establishing a design/build contract.
4. Design/Build requires a philosophical shift by the DOT’s staff to accept the changed roles on the project.
5. The project was awarded on a lump sum contract basis

Design Process

The design process used on the project was one of the great success stories of the project. By using partnering and “over the shoulder” reviews in a task force process UDOT staff was intimately involved in the design and decision making processes.

1. Partnering with the contractor is essential to a successful design process
2. Co-location of staff from both Owner and Contractor was very successful in the development of a “partnering” spirit on the project.

3. “Over-the-shoulder” reviews involved the Owner’s staff in the design process and facilitated the review of the design documents.

Quality Control/Quality Assurance Process

Assignment of quality control and quality assurance duties to the Contractor was a significant challenge on the project. There was broad acceptance within UDOT for assignment of materials testing duties to the Contractor but less support for assignment of the roles of construction inspection and quality assurance to the Contractor. The Owner also had responsibility to the FHWA to provide final acceptance of the finished project. The development of a partnering agreement and subsequent procedures for accepting “equal or better” substitutions for construction elements proved to be invaluable in resolving changes made in the construction of the project. This resulted in no claims being made on the contract and minimized the change order processes.

1. A materials testing laboratory required almost a one-year time period to fully AASHTO certify so this must be programmed into the time schedule of the project.
2. A field procedures manual should be prepared during the RFP stage to clearly define roles and responsibilities for the construction work. On this project this manual was developed after the Contractor was selected and resulted in some delays in implementing a procedure to handle field questions and changes.
3. The cultural challenges resulting from the changed roles between the Owner and Contractor on QA/QC roles is significant and requires effort by both parties to develop appropriate acceptance of those roles.
4. UDOT has considered making the QA role a third independent party on future D/B projects.
5. “Equal or better” agreement resulted in facilitating approval of changes and reduced conflict in substitution of alternatives.
6. An “Award Fee” was established and intended as an incentive for performance and early completion. It was difficult to administer, oftentimes misunderstood and should be carefully evaluated before using this process on other projects.

Innovative Construction Methods

A Design/Build approach can facilitate and encourage the use of innovative approaches and methods to the construction. On a time sensitive project, such as this one, these opportunities are constrained by the demands of meeting the schedule. The most successful innovations used on this project either resulted in accelerating the construction schedule or developing designs most suited to the Contractor’s capabilities. Because this project was located in a potentially high seismic area, development of design criteria for seismic designs was an important element and required considerable effort by UDOT and the Contractor to develop. The project also resulted in the development of unusually long design life criteria for pavement and structural designs, 40 and 75 years respectively.

1. The use of wick drains in the soft foundations located within the project was very successful and expedited the construction of the project.
2. Geofoam was used where the cost of relocation of utilities was excessive or where insufficient time was available to use either wick drains or more traditional settlement techniques.
3. Two-staged MSE walls worked successfully to manage the settlement (as much as two meters) induced by the new construction.

Performance Specifications

A combination of specification types was used on the project with performance specifications used where the outcomes could be clearly defined and measured to determine compliance with the intent. Where

UDOT wanted specific outcomes a prescriptive specification was found to be more valuable. This project involved the development of many performance specifications because highway construction examples often did not exist when the project started.

1. Use performance specifications where performance and outcome are measurable within the contract time period.
2. Where specific outcomes are desired by the Owner use a prescriptive form.
3. Having the Contractor provide maintenance of the original facilities during construction was not practical and UDOT assumed that responsibility once the project began. The Contractor did maintain his new construction elements prior to Owner acceptance.

Partnering Process

Partnering played a vital role in the successful completion of the project. The partnership between the Contractor UDOT was maintained throughout the project life. A similar partnership was begun with the railroad coordination but not carried through the entire project. In retrospect UDOT would have preferred to extend the process with the railroad throughout the entire contract time.

1. Development of a partnering process for Design/build is highly recommended to manage the many issues that arise.
2. Use partnering wherever possible in dealing with various parties to the project.
3. Partnering requires reaffirmation of the process at frequent intervals by the project leadership and strong leadership at all levels of the team.

Public Information

UDOT and the Contractor developed a well-defined public information program and assigned responsibilities where the type of information rather than task was used to divide the roles. UDOT assumed the roles of vision and progress messaging. The Contractor was given the role of providing coping information to the public. The public information program resulted in a very high public acceptance level for the project and image for the I-15 Team in spite of the extensive disruptions the construction presented to the driving public. The team made extensive use of market research to develop the public information program and make adjustments to it during the course of the project.

1. It is essential to provide a coordinated message throughout the program.
2. Research techniques such as public opinion surveys, focus groups, and other methods were used extensively to monitor effectiveness and provide direction in modifications to the plan.
3. Use both paid and free media outlets to get the message out. The advantage of paid media advertising is the message can be more accurate, correct and consistent.
4. Consider hiring professionals to assist in executing the program.

CHAPTER ONE: SELECTION/AWARD PROCESS

This chapter describes the selection and award process used by UDOT to select the design-build contractor. The Transportation Research Board (TRB) published a portion of this material in their annual meeting report for 1999. The report, “Use of Best Value Selection Process; Utah Department of Transportation I-15 Design/Build Project”, was published in the TRB Journal number 1654. The information in this chapter is an expanded version of the TRB report and includes several documents used by UDOT in the selection process that were not included in the TRB version of the report.

DESIGN-BUILD AS UDOT’S PREFERRED DELIVERY METHOD

UDOT opted to use the design-build process for several reasons:

- Significant time savings potential
- Potential to reduce driver inconvenience with a shorter construction period
- Desire to complete the I-15 Project prior to the 2002 Olympics
- The ability to define costs early—funding for the I-15 Project had not completely secured, and having a firm price for the work from a design-build contractor enabled UDOT to complete the funding plan

COMPARISON OF THE DESIGN-BUILD PROCESS TO TRADITIONAL CONTRACT

Traditional Contracting Approach

Public agencies have predominantly relied on competitive bidding to award highway construction contracts. This process involves preparing detailed plans, specifications and estimates for the work involved, a solicitation of bids through public advertisement, and award of the contract to the lowest responsible bidder. Permits to construct the project are obtained by the DOT from appropriate agencies prior to bid advertisement. This may involve permits from environmental agencies and water management authorities. Agreements with railroad and utility companies, and cooperation and maintenance agreements with local jurisdictions are also obtained beforehand. All necessary right-of-way and construction easements are determined and acquired prior to contract advertisement.

The basic intent of this approach is to minimize risk to the contractor by defining all requirements of the project and eliminating most unknown conditions. Any errors and omissions in the plans or unforeseen work are the responsibility of the agency. Quality is assured through prescriptive plans and specifications coupled with construction oversight and inspection by the public agency. Competitive bidding among contractors who have been pre-qualified by the agency to perform the work controls the cost.

The Design-Build Process

The design-build process involves contracting for both design and construction services from a single Contractor. The Contractor is responsible for completing an acceptable final design for the work to be constructed and the actual construction of that work. The Owner is responsible for adequately defining the intended scope, schedule, purpose, function and outcome related issues of the project but the Contractor is provided with flexibility to determine how to complete the design and construction of the facility within the parameters established by the Owner. The Owner can choose to define as much or as little as they chose to govern the Contractor’s work.

For the Owner, determining what role their own staff will play in the process and assigning responsibility to either their own staff or the Contractor for elements of the project becomes a major role. Permits, agreements with railroad and utility companies, cooperative agreements with local governments and agencies and other elements may or may not be assigned to the Contractor team to execute. Many times, because of legal limitations and unique expertise involved, the responsibility for right-of-way acquisition is assumed by the Owner.

The Contractor may also be responsible for construction inspection and quality control activities. Normally these are provided by the Owner under traditional contracting methods.

Reasons to Choose Design-Build

The decision to use this design-build approach is usually schedule driven. By combining the design and construction in one procurement, significant time can be saved. Procurement of materials and actual construction may begin prior to completion of plans and specifications. Equally important, by combining the expertise of the designer and builder more efficient design, construction sequencing and maintenance of traffic schemes may be achieved thereby reducing contract time and improving performance of the facility during and after construction. Additionally, having design and construction responsibilities under “one roof” can result in time reductions in the design process. The maximum contract duration is usually specified by the agency and usually it is left to the design-build team to propose any modifications to shorten it and considered one of the criteria in selecting the best proposal.

Selection Process

The selection process normally involves a qualitative evaluation of proposals from pre-qualified teams. Rankings for schedule, quality, technical factors and cost are developed based on predetermined criteria. The Owner has wide latitude to consider technical factors that are deemed important to the project in the evaluation process. Technical rankings are then combined with the proposed cost to determine the best value and recommend award of the contract. A more common approach involves competitive ranking of interested teams based on technical qualifications and past experience. The agency may chose to reduce the number of firms considered by “short-listing” those firms considered best meeting the pre-qualification criteria. A “shortlist” of design-build teams submit a proposal for the contract and the award is made to the lowest responsible proposer. This approach reduces the influence of qualitative rankings in the ultimate selection, but tends to minimize innovation by the teams.

Risk Factors

The design-build approach shifts a larger portion of the risk from the Owner to the contract team by requiring plans, specifications, and estimates to be the responsibility of the contractor. Plan errors and omissions and unforeseen work are the design-build team’s responsibility. This aspect of the design-build process is significant in reducing contract disputes, claims and cost increases during construction. However, because the contractor assumes more risk, the price may be increased accordingly. The cost of increased risk may be offset by innovative design, early procurement of materials and overlapping the design and construction phases. Since most design-build procurements are, in effect, lump sum contracts the agency has greater confidence in cost containment. Financial planning for major contracts using the design-build method is therefore more predictable than traditional contracting methods.

RISK/RESPONSIBILITY CATEGORY	100% OWNER	TIME EXTENSION ONLY	PRICE INCREASE ONLY	DESIGN BUILDER	INSURABLE	REMARKS
DESIGN PROCESS						
Final Alignment Geometry Responsibility				X		D-B's ability to change the alignment will be subject to various constraints
Original Geotechnical Data	X					UDOT will not be responsible for conditions in areas not covered by geotech reports
Design Criteria	X					UDOT is setting the criteria
Design Review Process	Delays which UDOT causes			All other costs and delays		UDOT may generate owner-owned float by expediting the review process
Changes Resulting from Design Review Process required by specifications				X		D-B must comply with specifications
Changes resulting from Design Review Process not Required by specifications (a.k.a. change in specifications)	X					UDOT must allow the D-B flexibility within the constraints set by the contract documents, and must pay for any changes in the requirements (other than changes under \$10K)
Differences between Design Proposal and 100% Design				X		
Design Defects				X		
Constructability of Design				X		
Efficacy of Design				X		Unless defect is inherent in the UDOT specifications
RIGHT-OF-WAY/RAILROADS/UTILITY RELOCATION PROCESS						
Establishing ROW Limits	X					Subject to change through VE process
Obtaining ROW	X					Contractor will assist in VE related acquisitions
Alignment Change Creating Need for more ROW	VE			VE		
Coordinating with Railroads				X		
Identifying Utilities; Entering into Utility Agreements	X					UDOT will pay additional costs for any additional facilities discovered unless they result from alignment changes

Figure 1-1. Risk/Responsibility Allocation Chart A

RISK/RESPONSIBILITY CATEGORY	100% OWNER	TIME EXTENSION ONLY	PRICE INCREASE ONLY	DESIGN BUILDER	INSURABLE	REMARKS
Coordinating with Utility Owners				X		
Utilities Requiring Relocation Because of Alignment changes				X		
Performance of Design and Construction Work				X		In some cases the facility owner will design and/or build; the D-B will do the work if the owner does not.
CONSTRUCTION						
Quality Control and Quality Assurance	Oversight only			X		
Construction Survey				X		
Control Survey	X					
Supply of Equipment, Materials and labor				X		
UDOT provided items	X					
Coordination of Construction				X		
Coordination with other work				X		
Coordination with outside work	Execution			Planning		
Defects in Early Construction				X		UDOT can elect to require work to be redone or can assess a fine
ENVIRONMENTAL COMPLIANCE						
Obtain Environmental Approvals	(Major)			VE		
Performance of Mitigation Measures	As per Mitigation Monitoring Program			All other		
Known Hazardous Waste	X			Payment on a Unit Price Basis		UDOT will be listed as the generator on hazardous waste manifests
Unidentified Hazardous Materials	X			Payment on a Unit Price Basis		UDOT will be listed as the generator on hazardous waste manifests
PERMITTING						
Obtaining Permits				X		UDOT will provide a list of required permits
Performance of Permit/Local Agency Requirements				X		

Figure 1-2. Risk/Responsibility Allocation Chart B

RISK/RESPONSIBILITY CATEGORY	100% OWNER	TIME EXTENSION ONLY	PRICE INCREASE ONLY	DESIGN BUILDER	INSURABLE	REMARKS
ITEMS BEYOND ANY PARTY'S CONTROL (FORCE MAJEURE)						
Differing Subsurface Conditions			Allowance	Allowance		
Strikes/Labor Conditions				X		
Weather Conditions				X		
Catastrophes – Fire, Flood, Earthquake	Major Earthquake		No delay damages	Fire, Flood	X	
Third Party Litigation		X			Maybe	
Archaeological Resources/Endangered Species/ Cultural/Biological Resources	UDOT will perform any mitigation work	X				
War, Sabotage, Etc.		X				
Changes in Law	X		No delay damages			
Fuel Price Changes			X			UDOT standard clause (price can be adjusted up or down)
Other Force Majeure		X				
AGENCY COORDINATION, PUBLIC EDUCATION and INVOLVEMENT						
FHWA	X					
DAQ				X		
Other Agencies	Some			Some		
Community Relations	Lead			Award Fee		
PROJECT COST						
Funding/Cash Flow	Payment Cap			Any additional funds needed		UDOT has option to require D-B to obtain financing or UDOT can pay-as-you-go
Interest Rate Risk				X		D-B will provide fixed option price for financing and will therefore bear interest rate risk
Inflation	Maintenance			D-B Work		
Bid Preparation Costs	Stipulated Fee					

Figure 1-3. Risk/Responsibility Allocation Chart C

Risk Chart						
Risk/Responsibility Category	“Traditional” Design-Bid-Build		Typical Design-Build		I-15 Design-Build	
	Owner	Designer or Constructor	Owner	Design-Builder	Owner	Design-Builder
Final Alignment Geometry	X			X		X
Geotechnical Data	X			X	X	
Environmental Permits	X	X		X	X	
Design Criteria	X		X		X	
Design Defects	X			X		X
Constructibility of Design	X			X		X
Obtaining ROW	X			X	X	
Coordinating with Utilities & Railroads				X	Agreements	Coordination
Quality Control & Quality Assurance	Significant inspection & testing	Quality of Workmanship	Oversight only	X	Oversight only	X
Coordination with other work	X			X		X

Figure 1-4. Risk Chart

Advantages of Design-Build

In summary, the design-build process has a number of distinct advantages over the traditional design-bid-build process. They include:

- ***Single Entity Responsible for Design, Construction and Inspection.*** Communication and coordination are more effective, reducing conflicts and resolving disputes quicker.
- ***Reduced Risk to Agency.*** Clarification and/or correction of plans in the field are the responsibility of the contract team. Overruns, change orders, and supplemental agreements are virtually eliminated. Risk can be shifted more or less to the design-build team, depending on agency philosophy and nature of the project.
- ***Significant Time Saved.*** Construction begins during plans development. The team designs the project based on contractor's strengths (labor, equipment, and expertise).
- ***Firm Cost of Project.*** Lump sum contracting and transfer of risk to the contractor enable the agency to better predict costs. Improved reliability of cost estimate greatly improves financial management.
- ***Improved Quality.*** Teaming allows for greater innovation and creativity. Constructibility and maintenance of traffic are often significantly improved. More responsibility for construction quality is shifted to the contractor. Life cycle cost provisions, warranties, and long-term maintenance may be included in the contract to increase quality.
- ***Outsourcing/Privatization.*** This promotes greater utilization of the private sector in design and construction management. It is sometimes more efficient than hiring staff for a single major construction project or program.

PHILOSOPHICAL SHIFT TO IMPLEMENT DESIGN-BUILD

Transitioning from a low bid environment to a best value contracting philosophy can be challenging for any agency. Tradition and well-established practices are not easily modified. Employees become comfortable with long-established practices that have served them well, so that even when consensus is reached to implement an innovative concept, institutional inertia must be overcome. Successful deployment of the design-build concept is certainly dependent on a shift in agency philosophy.

Accountability Transfer

The traditional design-bid-build approach to contracting places the greatest risk and greatest control within the contracting agency. The agency is responsible for the design plans, specifications and estimate of quantities, and handles construction oversight to ensure quality. The contractor is solely responsible for constructing the project in strict compliance with the plans and specifications and within the bid amount. Design-build, on the other hand, transfers responsibility for the design plans, specifications, estimates and construction management to an outside entity—the design-build contractor.

All agency employees do not readily accept this shift in control and accountability. Outsourcing design responsibilities may be difficult in an agency that has traditionally handled such work with in-house staff. Agency design personnel may not feel confident that consultant design firms have the expertise to perform at the same quality level. Allowing the contractor and designer to collaborate on the design may raise concerns that quality may be sacrificed for profit. The same is true regarding the design-build contractor performing construction inspection. Concern that the “fox is guarding the hen house” is often an issue.

Critical Leadership

In order to achieve support and, hopefully, enthusiasm for design-build contracting, it is essential that agency managers exhibit strong leadership and commitment. Direct involvement in the process and support of the head of the agency, while not mandatory, greatly enhances the pace of project implementation. Inadequate support at the highest level renders implementation difficult, if not impossible. The agency must recognize the risks involved in the accountability transfer, accept them, and provide the support necessary to carry out the effort. This may require establishing a task force or steering committee dedicated to the project with strong leaders open to the change in philosophy and committed to seeing it through. Agency staff assigned to project implementation must be allowed to focus on implementation.

As more agencies experiment with and adopt design-build contracting techniques, the cultural changes required will be easier for others to achieve. Successful application of a new process by one’s peers greatly reduces the apprehension and concerns about the process.

“BEST VALUE” SELECTION

UDOT was concerned about awarding the I-15 Project based solely on low bids, since the proposers would not have detailed, complete plans to prepare the bids. UDOT further wanted to encourage all proposers to submit innovative ideas for both design and construction, which could be considered by the evaluation team in the overall evaluation process, and that subsequently could be used by the successful design-build contractor.

To achieve these objectives, UDOT developed a process they termed “best value selection” that resulted in selection of the firm that made the proposal considered the “best” value to the state of Utah. Proposal evaluation criteria and process were created to ensure the technical and cost proposals were evaluated

separately. Ultimately, a small, select group of individuals had knowledge of both the cost and technical evaluation results, and this group made the final selection of the contractor.

Use of Stipend

Because of the significant resources necessary to propose on a project like the I-15 reconstruction, UDOT felt it appropriate to reimburse the unsuccessful proposers with a \$950,000 stipend. The intent of this payment was to: 1) ensure a maximum degree of innovation and quality in the development of the proposals, and 2) to allow UDOT to own and share with the successful proposer any innovative ideas contained in the unsuccessful proposals. Each of the three proposers spent \$3 to 5 million to develop their proposals; the stipend primarily was used to reimburse the smaller subcontractors who participated in the proposal development. While the stipend apparently only covered approximately one-third of the development costs, UDOT believed it was a good faith indication of the agency's intent to proceed with the I-15 Project, especially since total funding had not been secured at the time the RFP was issued.

FHWA approved the use, but did not fund the award of a stipend to each of the unsuccessful but responsive proposers. They felt it was a means of compensating them for a portion of their proposal development costs as well as maintaining a competition that would contribute to design quality, innovation, and competitive price proposals.

Legislative Authorization

To enable UDOT to award on a design-build and "best value" basis, special legislative authorization was enacted. The authorization permitted UDOT to award on any one of the following conditions:

- Award to the responsible proposer offering the lowest-priced responsive proposal. If the RFP includes a mandatory technical level, no proposal shall be considered responsive unless it meets that level.
- Award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.
- If the RFP provides for a stipulated sum, award to the responsible proposer whose proposal is evaluated as providing the best value to UDOT.

•

Evaluation Process

The evaluation process supported UDOT's objective of wanting to select a design-build contractor based upon "best value" and not just the lowest price or capital cost. UDOT created a contracts management group whose function was to monitor the evaluation process, coach the evaluation teams through the process, and secure the integrity of the process by safeguarding all of the proposal information.

To fairly evaluate the merits of both the technical submittals and the price proposals, they reviewed each type of proposal independently and weighed them equally. The technical evaluation team was not given the price information so that their reviews would not be affected by the price. To further ensure impartiality, the price proposals were evaluated "blindly," i.e., without reviewing team knowing the identity of the firm who prepared the proposal.

Separate and distinct review teams were created for both the technical and price submittals. UDOT published a set of guidelines and held advanced training sessions with each evaluation team to assure that they understood their role and the requirements of their individual reviews.

The reviews by the individual review teams were located and scheduled so that they were conducted separately. There were strict controls over document distribution and confidentiality, and any references to the firm or its team members in the written price information were removed.

Technical Submittals. The Technical Evaluation Board (TEB), composed of eight people, coordinated the technical proposal review. The board supervised the detailed review of the proposal conducted by several technical groups, each of which evaluated specific technical areas of the proposal. Four primary technical areas were established, listed in the descending order of importance, as follows:

- Technical Solutions
- Work Plan/Schedule
- Management
- Organizational Qualifications

The technical solutions were further divided into several subfactor groups. The evaluation and selection organizational chart **Figure 1-1** shows each of the technical areas and the number of reviewers assigned to each. There was some duplication of team assignments with a total of 61 people assigned to the various technical review committees. **Figure 1-2** is a flow chart of the process used.

The technical reviewers assigned adjectival (rather than numerical) ratings in each area. The ratings were:

- Exceptional (E)
- Good (G)
- Acceptable (A)
- Susceptible to becoming acceptable (S)
- Unsatisfactory (U)

Reviewers could further distinguish rankings by adding a plus (+) or minus (-) to these grades for ranking. These grades were then weighted for the value or significance of the technical factor and a composite grade determined.

Price Proposals. The Price Evaluation Team (PET) evaluated the price proposals using evaluation forms that had been included in the RFP, which separated costs into specific areas for evaluation. The team checked the price submittals for accuracy, price realism, balance and reasonableness, which could then be evaluated by comparing with other proposers' prices, additional pricing data, and the UDOT independent estimate, prepared for UDOT by a large general contractor not bidding on the project.

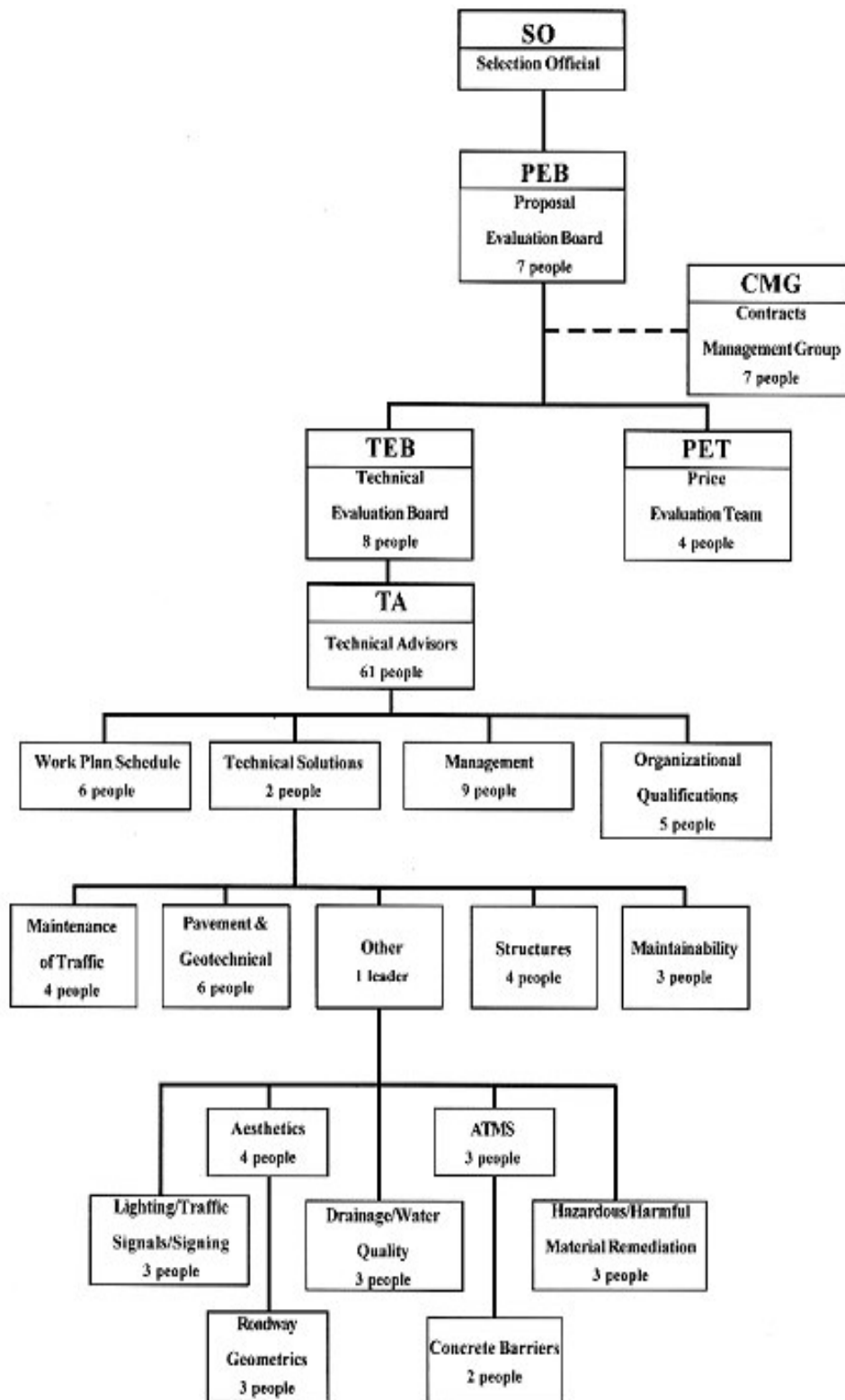


Figure 1-5. Evaluation and Selection Organizational Chart

Initial Proposal (I) _____
BAFO Proposal _____



Figure 1-6. Flow Diagram for Evaluation and Selection Process

Follow-on Discussions. UDOT had the option to award the contract on the basis of the initial review, or they could proceed to a “discussion” level of review and Best and Final Offer (BAFO). At this stage the review team could ask written questions of proposers to obtain additional information concerning their original submittals. The additional information was restricted to the following areas:

- Advising proposer of significant weakness or deficiency so that proposer could modify their proposal to meet the minimum standards
- Attempting to resolve uncertainties or obtain clarifications
- Resolving any suspected mistakes in the submittal
- Providing a reasonable opportunity for proposer to submit any price, technical or other revision. In this case, UDOT was only permitted to tell proposer their price was too high, too low and/or unrealistic.

To ensure an atmosphere of fairness, if discussions were begun with one proposer, discussions had to be held with each proposer. In lieu of oral discussion, written questions were submitted to each team for response. No indications were given on what the price should be or what other entities had proposed. During this process the review team was specifically prohibited from actions that could result in:

- Technical leveling. Making all technical proposals essentially equal
- Technical transfusion. Tipping-off proposers of other teams’ ideas
- Auctioning for better prices. Trying to get proposers to reduce their price

Interviews. After the discussions were completed, UDOT held interviews with each design-build team. Each entity had two hours for a formal presentation to the review team. During a recess, the review team had time to formulate questions for the proposer. The interview was then reconvened and the questions were asked of the proposer.

Best and Final Offer. UDOT could have awarded the contract after the interviews, but took the option to request a “Best and Final Offer” (BAFO). This process was similar to the initial evaluation process, but the time permitted for proposers to revise their proposals was limited, as was the time for review. The process consisted of a short review to compare the revised submittal with the initial one and assign a new rating. Both the PET and the TEB compiled the ratings and recommendations were made to the selection officer.

Evaluation Board. An evaluation board was formed by UDOT to consider the technical and price proposal evaluations and develop a recommendation based upon all evaluations. The board was chaired by the Deputy Director of UDOT and they considered all of the evaluations and then made a recommendation to the Executive Director, who was designated as the Selection Official.

Award. The selection of the successful team was announced by the UDOT Executive Director at a news conference.

OWNER-PROVIDED INFORMATION

In addition to the items listed here, all of the information gathered through the early-action activities, as described in the following Risk Sharing section, was provided to the design-build teams as part of the RFP.

Performance Specifications

In preparing the RFP, UDOT quickly discovered that there were few performance specifications available for DOT type work and, therefore, decided to formulate their own. A small I-15 Management Team (a diverse mixture of six UDOT employees with their subconsultants) was assigned exclusively to the I-15 Project to advise and guide the task groups writing the specifications, and then review the specifications. The I-15 Management Team was separated from UDOT's other operations by moving them to their sub-consultant's office building.

Task groups of UDOT employees, personnel from the construction industry, and engineering consultants were assigned to develop specifications in areas such as pavement, structures, etc. More than 100 people were involved over a 9-month period in this effort.

30% Design Plans

UDOT elected to provide to proposers with what was termed as "30%" plans, which included alignment of the I-15 Project and extensive geotechnical investigations conducted within the corridor. UDOT had previously hired several consulting firms to develop the segments of the I-15 Project to this level of design, with emphasis on development of functional geometrics for the highway and typical bridge sheets for each structure, and the geotechnical investigations. This level of design was needed to identify conflicts with utilities and railroads and determine what additional right-of-way would be needed so that UDOT could fulfill their commitments to obtain all rights-of-way, permits and utility agreements for the contractor as part of their risk sharing on the I-15 Project.

Final Plans "Sealed Sets"

UDOT actually completed final plans, signed and sealed by consultants, for portions of the work—the 600 North Interchange Structure being one example. It was thought important to include these completed documents to accelerate the start of construction. While this was successful in providing an early start to the construction there were several problems associated with using these plans. Those included difficulty in integrating the architectural treatments added by the RFP into the designs, modifications to design elements to suit the contractor's methods and equipment planned for use on the rest of the project and other similar issues.

Geotechnical Information

UDOT included the results of previously completed geotechnical subsurface investigations in the RFP. Comprehensive geotechnical investigations had been conducted at every bridge and pier location, embankment areas, and other structures to document foundation information. The extensive data included exploration work, soil log information, drilling logs and materials testing and lab reports. No interpretation of the information was provided, however. This was left up to the design team.

RFP on CD Rom

The scope of the RFP resulted in more than 40,000 written pages of instructions and information, in addition to 30,000 pages of drawings and the geotechnical subsurface investigations reports. Each design-build team needed all of the information to prepare their proposals. UDOT placed all of the documents on four indexed CD-ROMs and distributed a set to each proposer. A hard copy was available for examination at UDOT's office, but no hard copies were distributed.

RISK SHARING

One of the areas where UDOT made the greatest contribution to innovation during the selection stage was in the area of risk management. The agency undertook the I-15 Project with the philosophy that the entity with the best ability to deal with each area of risk should accept the specific risk. They developed a risk matrix used to identify the risk(s) and determine who was best suited to manage that risk. Using this process they accepted certain risks as the DOT, assigned some to the Contractor and shared some with the Contractor, depending on the DOT's assessment of who could best accept the risk. Copies of the Risk/Responsibility Allocation Chart and Risk Chart are shown in Figures 1-3 and 1-4, respectively.

Insurance

After many discussions with other agencies and firms that have dealt with large design-build projects, UDOT concluded that there was a potential saving if the state purchased and managed most of the insurance required for the I-15 Project. UDOT developed an owner-controlled insurance program (OCIP) that was projected to save up to \$20 million dollars in insurance premiums over the more traditional approach. The OCIP was purchased from an insurance specialist by UDOT under a separate procurement. The broker purchased and managed most of the insurance policies and plans needed for the I-15 Project. It covered worker's compensation insurance and several types of liability insurance. The design-build contractor was required to prepare a very extensive safety plan and obtain approval from the insurer early in the contract. To provide additional safety incentive, the design-build contractor was to share in any reductions to the insurance premiums as a result of safe job performance.

Disadvantaged Business Enterprise (DBE)

There was a reduction of the DBE required participation on the project based upon the available market for DBE firms in the Salt Lake City and Utah areas.

Subcontracting Requirements

Because of the obvious difficulty involved in tracking the amount of subcontracted work on a design-build project of this magnitude, the FHWA waived the provisions of 23 CFR 635.116, which required prime contractors to perform at least 30% of the work.

Changed Conditions Clause

FHWA also permitted UDOT to modify the standardized changed conditions clause required under the provisions of 23 CFR 635.109, because many of these clauses, such as quantity overruns, are not applicable to design-build contracts. The changed conditions clauses that were written into the contract were reflective of UDOT's desire to assume a fair share of the contractor's risk and minimize the dollar value of risk contingencies included in the bid price.

Performance Bond

Typically, highway construction projects require performance and payment bonds that equal 100% of the contract bid price. The initial research by UDOT's I-15 Management Team indicated that it would be very difficult to find surety firms that were individually capable of, or willing to, underwrite performance and payment bonds in excess of \$250 million. After much discussion, it was concluded that a \$250 million bond would be adequate to protect the interests of the state Utah, and this bond amount was a requirement in the RFP.

Early-Action Items

UDOT bought all of the rights-of-way, negotiated master agreements with the railroads and utilities, obtained environmental permits, conducted hazardous materials investigations, and provided drainage and mapping data. These early-action items were evidence of UDOT's willingness to share risk and provide as much information to the design-build teams as possible as they prepared their proposals.

Right-of-Way. When the I-15 Project was awarded, there were several right-of-way (ROW) parcels not yet acquired. To resolve this issue, UDOT established a ROW acquisition plan for inclusion in the design-build contract. In the ROW plan, UDOT committed to the parcels being acquired and being available to the design-build contractor by certain dates so that operations would not be delayed.

UDOT took responsibility for all right-of-way acquisition and began acquisition approximately nine months prior to issuing the Notice to Proceed. The acquisition plan was provided to the design-build teams prior to issuing the RFP. UDOT committed to acquiring one-third of the parcels prior to the Notice to Proceed and the balance on a schedule provided to the Contractor. Right-of-Entry was obtained for the parcels not yet acquired so the Contractor could proceed with work prior to the completion of the acquisitions. A total of 350 properties were acquired.

The design-build contractor was responsible for obtaining all construction easements, including those required for staging areas and haul roads. The contractor could however, elect to have UDOT acquire these and reimburse UDOT for any costs. Wasatch elected this option.

Utility Master Agreements. UDOT prepared master agreements with the utility companies prior to the “Notice to Proceed” which identified who would design, review and construct utility relocations and betterments, and who would pay for the work items. The design-build contractor was responsible for negotiation with the utility companies on individual utility construction work agreements. UDOT retained responsibility for all the final contracting and payments. There were approximately 1,500 utility crossings, with 800 conflicts identified for relocation.

The project paid for all conflicting utility designs and relocations. The cost of utilities was bid as a lump sum with the burden of delays shared equally between UDOT and the design-build contractor. The design-build contractor was reimbursed for all identified utilities that were impacted. If the design-build contractor was able to reduce the number of relocations, the design-build contractor’s reimbursement was not reduced which provided an added financial incentive to minimize conflicts. Betterment to the utility’s facility was a utility company fiscal requirement and was not a part of the project’s expense. Payment for betterments was made by the appropriated utility through UDOT to Wasatch.

Wasatch generally performed design and construction, and the utility companies reviewed and approved plans and construction. Wasatch hired two separate engineering companies who had previously worked with the utility companies to complete the designs in accordance with the utility companies’ requirements. Two utility companies did their own design and construction - US WEST and Utah Power. These companies had previously commenced advance work on their own facilities and wanted to complete their own work.

Railroad Master Agreements. Although UDOT negotiated the original corridor wide master agreement, all railroad-permitting activities were to be completed by the design-build contractor. Any costs incurred due to delays by the railroad were to be shared equally between UDOT and the contractor.

Environmental Permits. All environmental permitting was completed by UDOT and provided to the design-build teams for their proposals. By contract UDOT required that the design-build contractor conform to the conditions of the permits.

Hazardous Materials. Hazardous material investigations were performed prior issuing the RFP. Based on this investigation, UDOT established a budget and requested bids on quantities from the design-build teams. The hazardous material quantities were bid using unit prices that reduced the risk to the design-build contractor. These unit prices were renegotiated if estimated quantities were found to be significantly different than estimated.

Drainage. Quantities of permissible discharge flows (e.g., discharge restrictions into the Jordan River and other channels) were established by UDOT prior to release of the RFP. UDOT verified that these quantities were reliable for bidding and construction purposes and documented them in the Project Drainage Report. Any agreements and permits required were completed by UDOT prior to or during construction.

Mapping. UDOT furnished a complete digital terrain model with contours of the entire corridor that was made available in digital form to all proposers during the development of their proposals. Wasatch's consultants did some supplemental surveying to confirm specific locations, but generally the mapping furnished with the design was adequate for most of the design work.

ISO 9000 CERTIFICATION

UDOT contractually required all of the major firms in the design-build team, including the independent firm responsible for construction QA, to have an active quality program in conformance with ANCI/ASQC Q90001 (ISO 9000). This is an internationally recognized certification process used to assess the implementation of quality control processes throughout an organization. To comply with the contract requirements, the firms had to be ISO 9000-certified within 12 months following Notice to Proceed.

This requirement offered the potential for improved QC inspection and documentation, less rework, and less lost time and expense, and improved the delivery of this design-build project over previous projects without the requirement. While the certification by itself cannot guarantee a quality product, it did provide a documented process for integrating quality control with production activities and was consistent with UDOT's emphasis on quality. As part of the QC/QA Program, the use of ISO 9000 processes supported the I-15 Project goal of faster production and earlier completion.

AWARD FEE

UDOT included an Award Fee in the design-build contract as a financial incentive to ensure performance at or above expectations and the completion of the I-15 Project construction on or ahead of schedule. The total amount available for award over the life of the contract was \$50 million. Pre-determined amounts—identified in the design-build contract—were to be awarded semi-annually. An incentive of \$5 million was specifically targeted and was to be paid if the contractor were substantially completed 90 days or more ahead of the stated target date of October 15, 2001.

The original procedures for evaluating performance and awarding the fee were adapted from the U.S. Navy. UDOT revised the procedures several times to provide clarification and outline a more objective method of judging performance.

The amount of compensation was based upon criteria that were judged to represent the most critical elements of the I-15 Project:

- Timely Performance
- Quality of Work
- Management
- Community Relations/Maintenance of Traffic

Approximately 50% of the Award Fee was based upon the design-build contractor meeting or exceeding Timely Performance goals. The balance of the fee could be earned by a satisfactory evaluation of the

design-build contractor's performance in the areas of Quality, Management and Community Relations/Maintenance of Traffic.

Three levels of performance review were used to determine the Award Fee, with evaluations made monthly by project engineers and management staff. Upper Management and the Executive Director of UDOT conducted performance reviews on a semi-annually. The Executive Director made the final determination of the amount of award.

LESSONS LEARNED

This section presents a summary of some of the lessons learned on the selection and award process.

Commitment Level of DOT Staff

It was important that UDOT assigned personnel who were willing to learn and accept a new way of conducting business when embarking on the first attempts at a design-build project. This was needed to develop an acceptance of new ideas and procedures and to reduce the tendency to want to return to the tried and true processes.

Use of Stipend

A stipend should be considered if the effort to prepare the proposal is thought to be extraordinary or the Owner wishes to own the ideas developed by each team for possible use on a project. Also, it should be considered if an Owner feels that there is a need to show good faith to contractors that the project will proceed as planned.

Best Value Selection Method

UDOT felt that the use of "best value" rather than low bid was critical to the success of the I-15 Project.

Confidential Selection Process

UDOT felt that maintaining absolute confidentiality during the proposal evaluation was essential to the success of the selection and award process. It resulted in acceptance of the selection process and assured fairness in the evaluation.

Owner-Provided Information

After award of the contract, the question was asked whether UDOT needed to provide the level of detail they did to obtain responsible bids for the work. Interviews with both the winning team and losing teams indicated that they could have prepared their proposals with less information. The detailed information provided by UDOT was intended to reduce the potential risks by defining UDOT's commitment, and apparently was successful in achieving this goal; however, many of the proposers felt much of the information provided was more than was necessary.

Geotechnical Information

The consensus by all parties was that the level of geotechnical information provided was a great value to each team. It resulted in a significant amount of saved time for the contractor because it was only necessary to supplement that information to complete the designs. The estimated time saved on the I-15 Project was a minimum of one year.

One of the design teams indicated that much of the geotechnical investigation work performed for the viaducts was not as useful as it could have been since the contractor decided to relocate piers. This invalidated the site-specific geotechnical investigation performed at the locations of piers based upon UDOT's expectations of where they would be located.

Mapping

Wasatch thought this was a valuable resource for all of the design teams in that they could rely upon solid and accurate mapping information.

Sealed Sets

Both Wasatch and UDOT expressed strong concerns about having completed plans (“sealed sets”) in the documents. It was thought important to include these completed documents to accelerate the start of construction. While it accomplished this, there were several problems encountered as Wasatch sought to make changes in the plans to better suit their operations due to changed conditions in the field. UDOT has indicated that they would not provide completed plans for future design-build projects because of the problems experienced. The time saved is now viewed as less significant given the difficulties encountered with the changes.

Cost Estimates

UDOT found that it is important to provide complete public disclosure of cost estimates during the process of selection and award of the contract. This removed the potential for confusion about the process and its costs.

In retrospect, UDOT has indicated that they should have been more aggressive in updating their budget estimates of the I-15 Project by revising them each time the scope of the I-15 Project was modified to reflect current cost indices. UDOT strongly recommends that updates be done on future projects and that the overall estimated costs be released prior to releasing the RFP to proposers, if possible.

RFP on CD-ROM

UDOT believed using the CDs would save time for themselves and the proposing firms and save the expense of copying all of the information. However, this was not the case. It took up to three weeks for proposers to print and catalog all of the information, delaying them in proposal preparation. It was also difficult to organize the documents to determine if anything was missing. Most proposers had access to portions of the information because the engineering firms on their team had prepared the preliminary designs, but none of the proposers had access to all of the information from other sources.

UDOT continued to distribute condensed versions of the information on CD-ROM to interested agencies that wanted to have the bid document information. One version on a single CD-ROM contained all contract information and the Wasatch proposal but did not contain the engineering drawings and geotechnical reports contained in the original RFP.

UDOT has since concluded that this attempt to disseminate the information was unsuccessful and plans to provide printed copies of the information to potential bidders if they use CD-ROMS on future similar projects. They may still provide the CD-ROM versions, but at least one complete hard copy will be provided to assist in getting the information in the hands of bidders in a manner that is readily usable. Improved availability of technology among contractors may make this more efficient in the future.

Risk Sharing

The sharing of risk is a critical element of a design-build project. UDOT prepared a risk matrix before the I-15 Project was developed to determine the types and amount of risk and which party was best able to deal with the risk. They then assigned the risks to the parties best suited to deal with them.

Right-of-Way

There were problems encountered during design with the right-of-way as shown on the plans. Apparently, the detailed right-of-way research was performed on the areas where anticipated parcels were required by UDOT. In other areas the right-of-way was shown through a minimal amount of record research and was shown primarily as a line on a drawing. This was a concern to the design team in trying to confirm that they were staying within the right-of-way as they were completing design throughout the corridor.

Wasatch was responsible for the cost for any of the additional right-of-way required beyond that which was committed to by UDOT. It would have been better for the designers had UDOT tied down the right-of-way information more precisely on the drawings, either through reference monuments or ties to section corners so that the designers could have more confidence in the precise location of the right-of-way shown on the plans.

Award Fee

The Award Fee process did not function as well as UDOT or Wasatch expected. The program was revised and modified several times in attempts to improve its implementation, but even with the revisions, the process was viewed by UDOT as highly subjective, difficult, cumbersome to administer, and very time consuming. It was UDOT's opinion that the dollar amount of the fee caused both UDOT and Wasatch to focus too much attention on assuring that it be administered and paid appropriately, because of the formulas used to determine the Award Fee earned and the factors used to weigh the elements of the I-15 Project. The process did function as an incentive for schedule compliance, and Wasatch was awarded virtually all of the eligible amounts of the Award Fee.

There was concern that the amount of the fee had negatively influenced the partnering relationship between UDOT and Wasatch. Additionally, there was some negative public reaction to the Award Fee thought primarily to be due to a lack of understanding by the public of the reasons for the fee. Finally, the Award Fee is viewed by some as such a large portion of Wasatch's profit on the I-15 Project that a lot of attention was focused on earning the entire Award Fee and probably not enough focus on the other aspects of the project.

UDOT now believes that the incentive was not as necessary as originally thought and indicated that they probably would not include an Award Fee in future design-build efforts unless it were tied closely to tangible or quantitative deliverables such as milestones and less on subjective evaluation criteria.

CHAPTER TWO: DESIGN PROCESS

This chapter describes the design process, organization, staffing, and procedures used by Wasatch and their design consultant Sverdrup/DeLeuw on the I-15 Project. It also describes the changes made to the process as it evolved over the course of the project. The information is based on reviews conducted during the course of the design completed in 1998 and 1999. The end of the chapter contains Lessons Learned from the reviews.

MANAGING THE DESIGN PROCESS

UDOT issued the Notice to Proceed to Wasatch on April 15, 1997. The design process began in May 1997 and was completed by November 1998, approximately four months earlier than originally proposed by Wasatch. The design process produced more than 14,000 plan sheets along with supporting specifications and design documents.

Staffing Levels (Wasatch)

After Notice to Proceed, Wasatch mobilized design staff using the resources of their prime design consultants Sverdrup Civil, Inc. and DeLeuw Cather, (they formed a joint venture called DeLeuw/Sverdrup) plus 18 subconsultant firms. The organization used by Wasatch on the project is shown on **Figures 2-1** and **2-2**.

The decision was made to locate as many of the staff in one central location as possible. A large office building was leased and equipped to house the design staff, the construction administrative staff and UDOT staff. This location came to be called the “Hub.” At its peak there was a total of 350 design staff on location in the “Hub” during the most intense design period. An additional 140 off-site engineers, mostly bridge designers, were used to accelerate production of the design elements.

The design team had difficulty attracting enough bridge designers to move to the “Hub” and to Salt Lake City so a large portion of the bridge work was completed in outside offices. Additionally, some of the other work elements were completed in outside offices during 1998 when the design was accelerated, requiring additional design staff.

Staffing Levels (UDOT)

The I-15 UDOT Project Team staffing levels of 55 to 65 people remained fairly consistent throughout the project. The peak staffing period occurred during the right-of-way plan development and acquisition process. During the major design phase about one-third of the UDOT staff was involved in the design oversight process. As the design activities concluded, the staffing evolved to include more construction personnel.

Due to legislative limitations, UDOT was limited on how many staff could actually work on the I-15 Project. Since UDOT could not increase their total number of permanent full-time employees to work on this project, UDOT hired several consultants to assist and support them. Parsons, Brinkerhoff, Quade and Douglas (PBQ&D) were hired as the primary consultant to provide support for UDOT’s staff. UDOT also hired other firms, including a public relations firm and testing laboratory. Together the group functioned as a fully integrated I-15 Project Team.

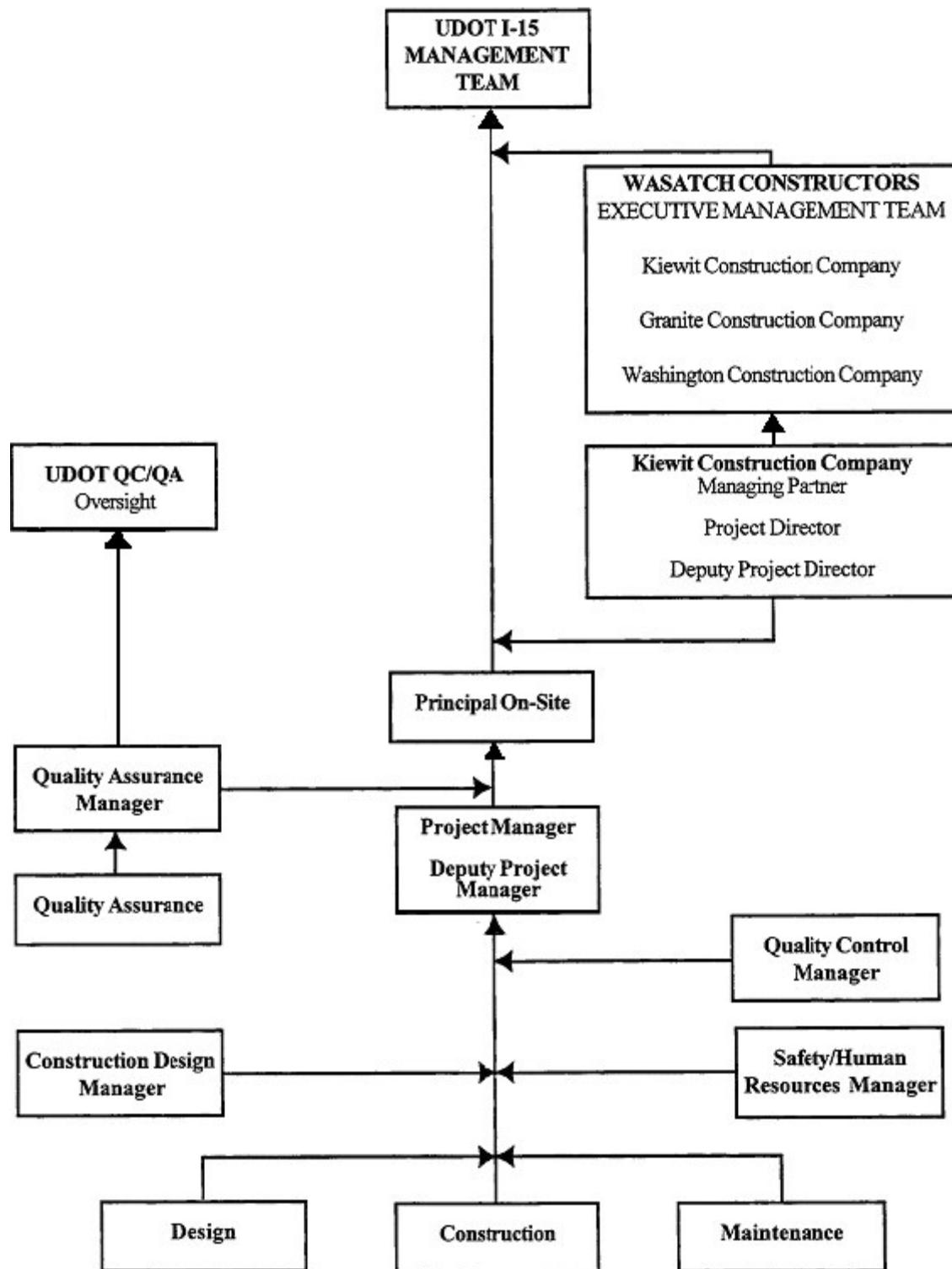


Figure 2-1. UDOT I-15 Management Team

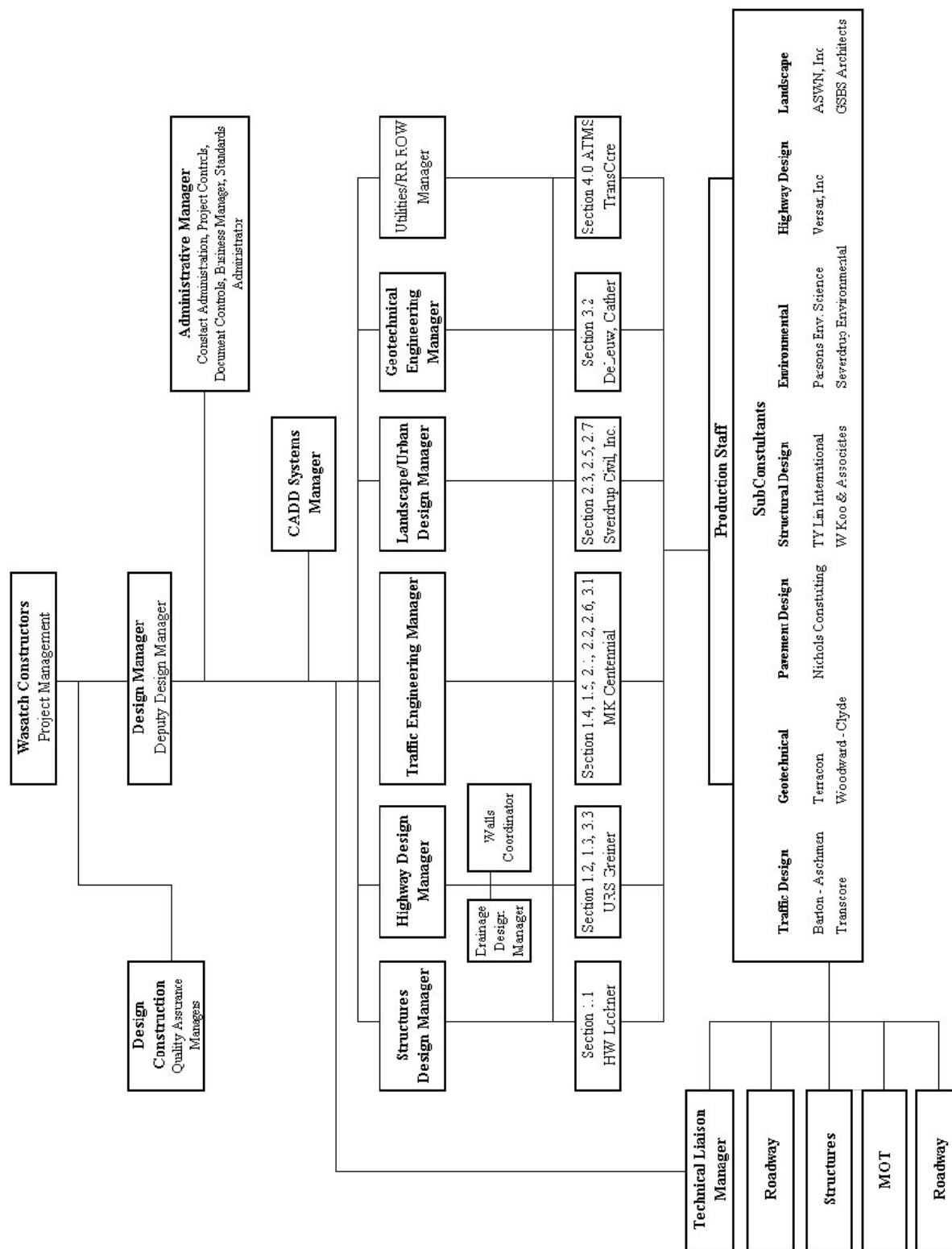


Figure 2-2. Wasatch Constructors Project Management

Many of the team assignments were composed of a mixture of UDOT and subcontractor staff, depending on the requirements of the assignment. This team made up of UDOT and consultant staffs completed all management and construction oversight tasks. PBQ&D assisted with administrative, technical design reviews, contracting, right-of-way, utilities, construction oversight, and railroad coordination activities. UDOT and another subconsultant handled public relations activities. Overall, approximately one-half of the I-15 Project Team was comprised of UDOT employees with the rest made up of consultants.

Scheduling

The construction schedule established by UDOT was the driving force for the design schedule. Project completion in the contract was established by UDOT as being October 2001, to be completed in time for the Winter Olympics in early 2002. Wasatch established an early date of July 2001 for completion and was successful in meeting this schedule.

As construction milestones were established, those dates were communicated to the Sverdrup/DeLeuw design team, and “Ready for Construction” plan releases were scheduled to meet those milestones. For example, some of the 142 bridges were determined to be on the early-action critical path and subsequently identified for early design completion.

Project Control Systems

To manage the design efforts, procedures to track drawing lists, master plan sets, revisions and versions were established. A document control system was followed religiously for keeping up with all of the documentation for the project. The Task Force groups used detailed meeting minutes to keep track of issues and decisions. Design issues were discussed in weekly meetings to ensure their timely resolution and were maintained on a list until resolved.

Computer Automation Requirements/Software

The design team used a single design and drafting software. This was a requirement for everyone involved in the project. The selection of the software was based on UDOT’s requirements to ensure compatibility with their existing system. MicroStation and InRoads were the software packages used for the project.

A CADD Task Force was established at the beginning of the project to address CADD issues. To implement this system was fairly easy and it was not a schedule issue.

A program called Resymbol (a Sverdrup program) was used to make sure the CADD files met project requirements for drafting consistency. This program was used to review all submittals, especially those from external consultants. For the most part, this process worked fairly well. However, in one instance it took approximately 360 hours to fix one of the submittals and bring it into conformance with the CADD standards.

In addition to the design software, the design-build team used a computer program called Expedition to manage the project’s electronic communication, including scheduling and timely distribution of the meeting minutes. This system was also used to track all communications.

Key Procedures

There were a number of key elements used by Wasatch to complete the design within the critical time schedule established by both UDOT and Wasatch. The following procedures were essential to completing the design on schedule.

Task Force Meetings

UDOT and Wasatch used a Task Force to provide direction and review to the design teams. Task Force meetings were held every week to coordinate the design approach, review tasks, resolve critical issues, and track progress and schedule. The Task Force comprised major discipline representatives from Wasatch, DeLeuw/Sverdrup, and UDOT.

It was during these review meetings that UDOT staff could monitor what Wasatch and the designers were doing and review design criteria and solutions. They also provided input on any design issues. Some Task Force meetings were discipline oriented, where specific design issues were discussed, such as roadway design, structures, geotechnical, method of handling traffic, and ATMS. Others were segment related where specific segment-related design issues were discussed and resolved. Copies of plans, specifications, and design details were made available to all parties prior to the Task Force meetings so that they could be examined prior to the meeting and any questions could be addressed during the meeting. If issues couldn't be resolved at the Task Force meetings, an escalation structure was used for resolving disputes.

Meeting minutes were distributed to document decisions and resolutions on key issues. These minutes served as the record of the decisions and were referred to when field questions were encountered.

The Task Force meetings involved UDOT at very early stages of development of criteria and plans, where decisions were made as to how to proceed. This daily involvement with the design team resulted in having UDOT staff very well informed about the design and in agreement with the design decisions that were used on the project.

Value Engineering Savings Incentive

Another procedural example was the sharing of value engineering savings with the design-build contractor. The design-build contract allowed the Contractor to receive 50% and UDOT to retain the other 50% of any savings achieved. Wasatch agreed to share a quarter of their portion with the prime design consultants. However, these saving incentives were not shared with subconsultants to the prime design team.

The “Hub”

UDOT and Wasatch's construction and design teams were all located in the same building, referred to as the “Hub.” From everyone's perspective, this was crucial for the success of the project. This co-location enhanced communication among all parties and facilitated in coordination, i.e., time was not wasted sending faxes, commuting to meetings, trading telephone calls, etc. Everyone also was connected electronically through the same computer network system, although secure areas were provided for each party. If there were any questions, the answers were just a few steps away.

During the peak period of design, approximately 140 designers were located off site. Consultants were used throughout the country, which made communication more difficult. Not only was it harder to keep the off-site designers up-to-date with the latest facts and information, they did not have the benefit of easy access to UDOT or Wasatch. This caused more time to be spent by the on-site design and management groups to coordinate these off-site work tasks. Since there was no more space left in the building to house

additional designers once it was decided to accelerate the design process by four months, the additional staff was housed at remote office locations.

UDOT's I-15 Project Management Team members were all located in the "Hub." This was viewed as critical in meeting the aggressive design schedule and deadlines. It expedited communications and minimized the time spent in going back to headquarters to obtain approvals or support. UDOT's project staff was authorized to make most of these decisions. They also were involved on a day-to-day basis and were available for questions and coordination with the Wasatch staff. The weekly Task Force meetings were critical to achieve quick resolution of conflicts and keep the project on schedule.

Earned Value Reporting

Wasatch used a system called Earned Value Reporting to control operations. Because the contract called for a lump sum bid for the majority of the work, Wasatch thought it necessary to break the project into smaller sections. Wasatch staff felt that this was absolutely required to effectively manage this kind of project. Activities were tied to milestones with each milestone having work-hours associated with them. Increments of 40 hours were used. The system was integrated to include both design and construction activities. Wasatch and their engineers used electronic time card reporting so the hours spent on the project were tracked weekly (i.e., "real-time"). In addition, overhead direct costs were paid as a lump sum to reduce the amount of tracked cost items.

Partnering Program

Both UDOT and Wasatch viewed the Partnering Program as an essential element on this project. UDOT recommended an extensive partnering process as part of the contract requirements. Wasatch responded to this recommendation by establishing a formal process for partnering, including regularly scheduled partnering meetings with UDOT at several management levels. The partnering escalation process was very important and was used extensively to resolve project concerns. During the design process, there was only a single instance when an issue, not a technical design issue, had to go to the top of the escalation process. The reason given for that one issue was that it was a legal issue dealing with the Owner Controlled Insurance and the use of off-site trucking activities that could not be addressed by anyone other than the executive director of UDOT and his Wasatch counterpart.

DESIGN PROCESS

This section presents an assessment of Wasatch's design process and the design review process used by UDOT.

Project Segments and Design Packages

The I-15 Project was divided into three geographic segments for construction purposes. Each geographic segment was further subdivided into smaller sections for design development. This resulted in 13 separate final submittals: ten design section submittals, one corridor wide (standard plan) submittal, one Automated Transportation Management System (ATMs) submittal, and a final/sealed plans submittal.

Leading up to the final design packages, there were several early actions packages prepared to accommodate and accelerate the construction. These packages generally were developed for specific action items like foundation, utility, grading, etc.

The number of sheets per section submittal varied from 400 to 1500 sheets. The total number of sheets submitted was approximately 14,000. There were also approximately 350 standard drawings produced.

Reviews

UDOT did not have the staff and time to complete detailed design reviews they normally performed, and transferred the responsibility of conducting the detailed reviews to Wasatch. The Engineer of Record assumed the detailed design review responsibility when the documents were signed. UDOT staff functioned in more of an oversight role, similar to FHWA. This involved participation in the ongoing "over-the-shoulder" reviews and performing UDOT's audit function that was required as part of the project's Design Quality Management Plan (DQMP) to determine fatal flaws in the process or methods. Issues were discussed and resolved at the weekly Task Force meetings.

There were design reviews made at the 30%, 65%, 90%, and 100% design levels involving Technical Coordination Reviews (TCR), Discipline Coordination Reviews (DCR), constructability reviews, and Quality Assurance Audits. **Figures 2-3, 2-4, and 2-5** illustrate the design review process. Throughout the design, "over-the-shoulder" reviews became an integral part of the process and supplemented the design reviews.

"Over-the-Shoulder" Reviews. The "over-the-shoulder" review process was a new concept for UDOT. A design review in a typical detailed design process means reviewing the final/completed designs and documents, providing comments, and then reviewing the corrected plans. Emphasis is on the end product review. In contrast, the "over-the-shoulder" review means reviewing the project as the project is designed and obtaining consensus and buy-off on the design as it is being developed. The responsibility for the correctness of the plans is placed directly with the Designer.

At first it was expected that the "over-the-shoulder" reviews would be cursory reviews of the project design by UDOT as it progressed through the normal design review process. As it was implemented along with the weekly Task Force meetings, it actually involved UDOT staff in the design process at much earlier stages than is typical. With this exposure to the design, the scheduled reviews became much more efficient because UDOT staff had been involved throughout the process and already were intimately familiar with the design.

Design Team Reviews. Design team reviews were conducted at 30%, 65%, 90% and 100% design. They involved formal meetings for technical coordination and discipline coordination, as well as constructability and quality assurance audits.

Technical Coordination Reviews (TCR) and Discipline Coordination Reviews (DCR) were conducted in formal meetings with representation from Sverdrup/DeLeuw, Wasatch, and UDOT. FHWA and specialists, such as steel girder construction staff, were often invited to attend. UDOT was provided review sets for their comments.

After each review, checklists were prepared for each review comment. The review comments typically fell into one of four categories.

A = Agree

C = Ignore

B = Justify

D = Refer to Wasatch Constructors for constructability review

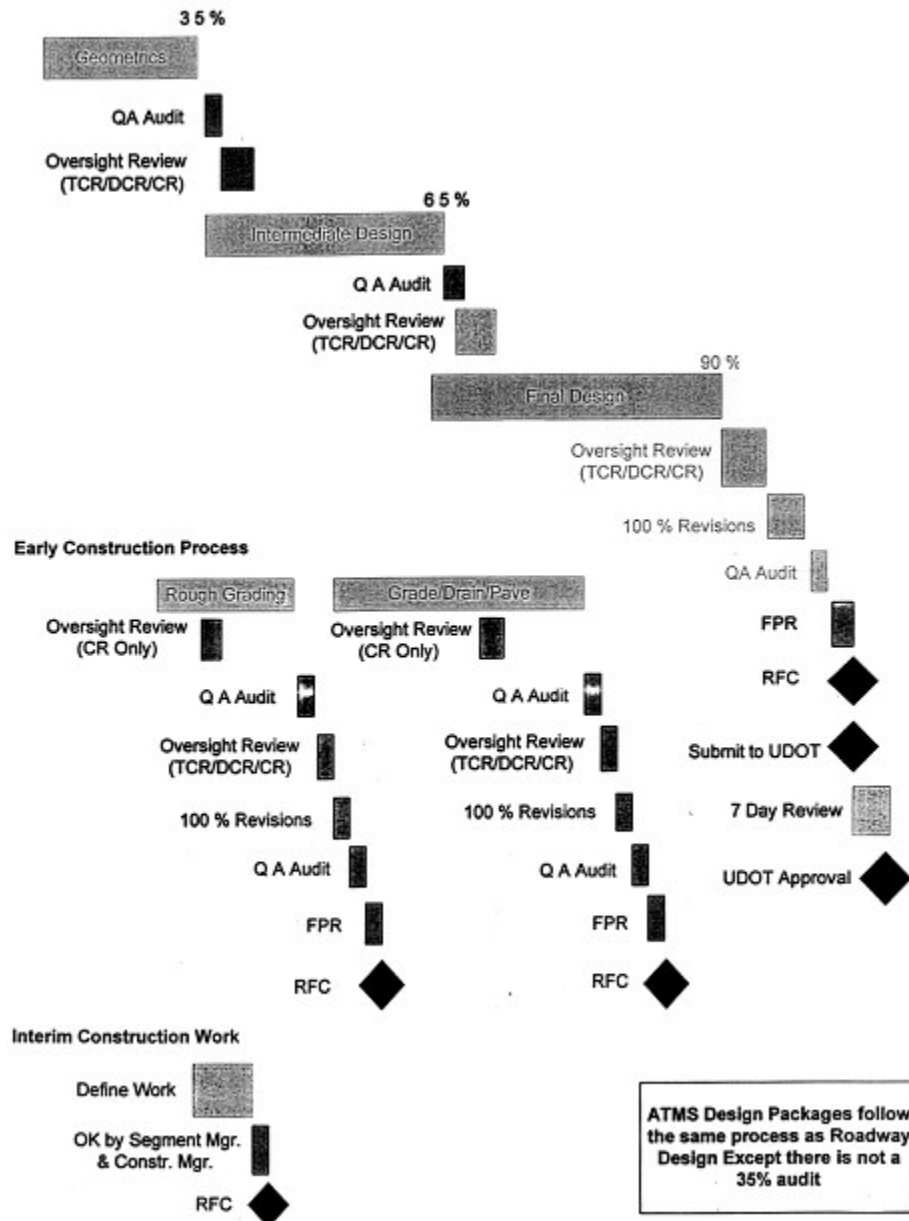
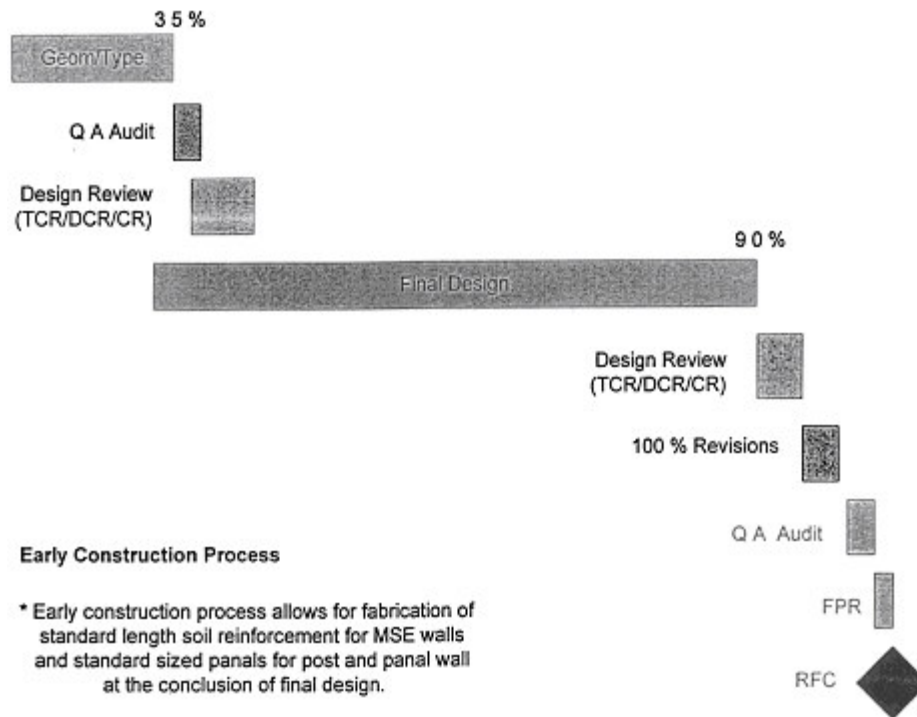


Figure 2-3. Full Design Process-Sheet 1



MAINTENANCE OF TRAFFIC DESIGN

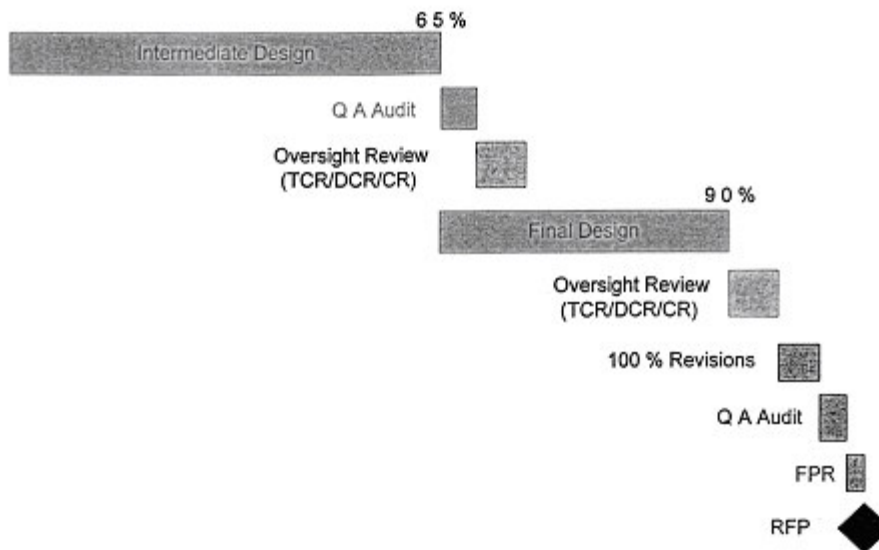


Figure 2-4. Full Design Process – Sheet 2

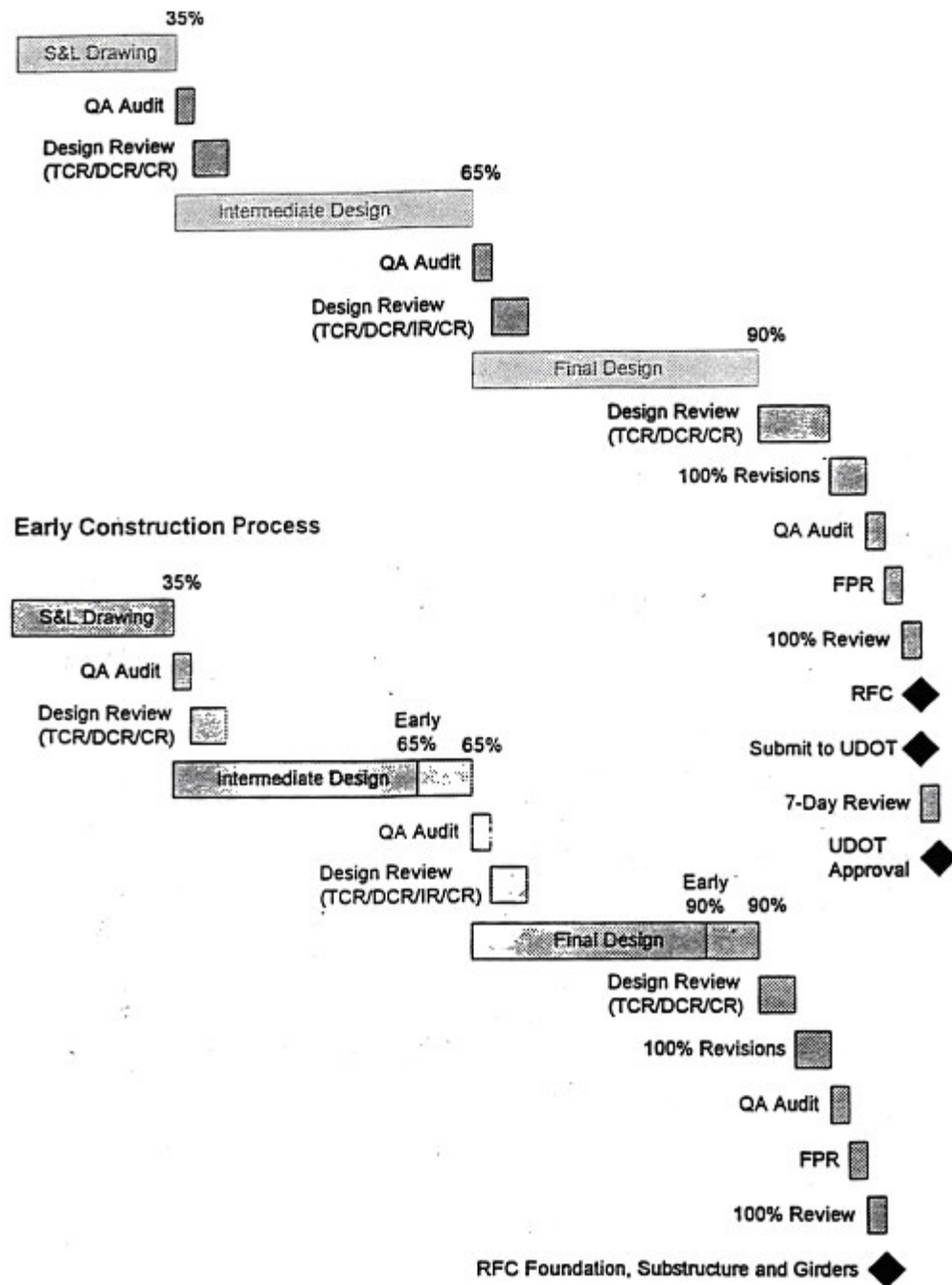


Figure 2-5. Full Design Process – Bridge Design - Sheet 3

These comments were then presented to the review team in the Comment Resolution Meetings (CRM) held for each review. A resolution of each comment was determined and direction provided to either accept or change the design.

Structural Design Process. Structure design had a more rigorous design process. Senior level engineers concentrating on critical or highly stressed areas of the bridges conducted independent reviews at each review stage, and the schedule for bridge review was different from the roadway reviews.

Unique to the structural design process were:

- Independent design reviews performed at the 80% completion level.
- Each structure was a separate line item in the schedule and tracked separately.
- Prior to being submitted to the QA Manager, each final design package was reviewed by the Structures Design Manager.
- Each structure went through a seismic review for compliance with seismic standards and specifications.
- Each bridge had a two-week final review by the two-person UDOT bridge review staff.

Of the 142 bridges on the I-15 Project, 134 were designed by the design-build team. The other 8 bridges had been completed by UDOT or one of their consultants prior to the RFP, and were included as “sealed plans” in the RFP.

Constructability Reviews. The purpose of the constructability review was to determine whether the design could be constructed. The constructability review was conducted by Wasatch and considered many factors, including:

- Consistency with design concepts
- Adequacy of information to construct the work
- Availability of materials, equipment and labor to construct the design
- Survey control verification
- Consistency with environmental mitigation requirements
- Maintainability
- Ability to construct the work
- Proper incorporation of review comments

In addition to the constructability reviews of each level of design, there were separate submittals for constructability reviews and staged construction. These varied throughout the process and were generally made part of the staged design submittals.

QC/QA Process for Design Phase

The entire design QC/QA process is included in Volume I of the *Design Quality Management Plan* (DQMP) of Wasatch’s QC/QA Plan for the I-15 Project, and was produced by Wasatch’s design consultant, Sverdrup/DeLeuw. The DQMP was prepared in conformance with the *Interpretive Guidelines for the Application of ANSI/ISO/ASQC Q9001-1994 for Owner’s, Designer’s and Construction Quality Management Systems*, April 1995, issued by the Design and Construction Division of the American Society for Quality Control.

The initial development of the QC/QA process was a big challenge requiring several months to complete. Once developed it took three to four months for Wasatch to fully implement. Each member of the design team received training on the process.

Wasatch Quality Assurance Audit. Quality Assurance Audits were required as part of the DQMP, and were conducted at the 30%, 65% and 90% review milestone by the Wasatch Quality Assurance Manager. The Quality Assurance Manager also performed internal audits every 6 months.

The Quality Assurance Manager checked that reviews and procedures outlined in the DQMP were followed. He also made sure they had been completed and documented, and that the QC process had been completed on the plans. Every plan submittal had a formal review and checking process. Wasatch required that completed QC process checks were made at 30%, 65%, 90% and 100%. The level of the QC process checks for each of these submittals was as if the plans were 100% submittals. This was time consuming and beyond the contract requirement of 50% and 100%, but Wasatch still required that QC be done on all submittals.

The Quality Assurance Review ensures conformance to project design standards and assures that the technical reviews of the designs have been completed. Every plan sheet released for construction was required to be formally approved by the QA Manager. Due to the fast-track nature of the project, most plan sheets were released more than once over the course of the project. Some plan sheets were released up to 5 times during various construction phases (i.e., grading, drainage, surfacing, etc.)

Wasatch's Quality Assurance Manager performed over 7,000 audits in 20 months. One person performed all of the QA audits.

UDOT Design Oversight Audits. In addition to the Wasatch Quality Assurance Audit, UDOT conducted audits during the design process on a weekly basis as part of their design oversight function. On average, UDOT conducted between 9 and 30 audits per month as part of their weekly oversight reviews. Their goal was to audit 10% of all designs.

UDOT used a two-pronged approach to provide design oversight. These consisted of:

1. Audit of Wasatch's actual QC/QA process and comparing it to the DQMP.
2. Weekly Task Force meetings with Wasatch's personnel to discuss design issues and perform oversight review of plans and specifications.

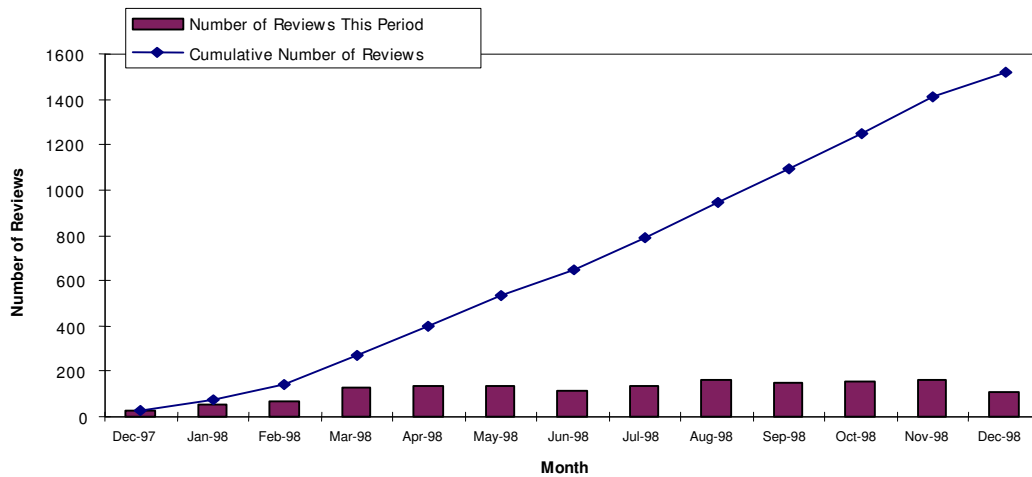


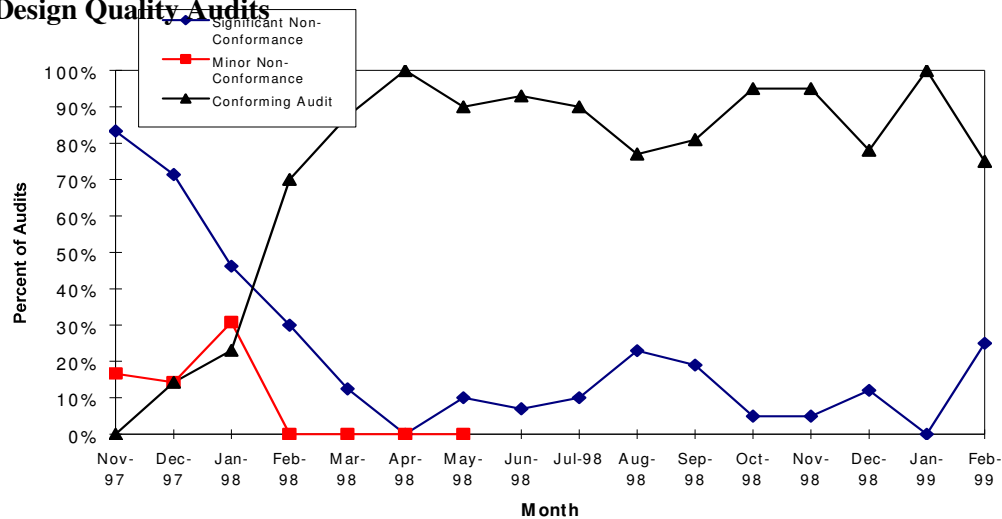
Figure 2-6. Number of Oversight Reviews Performed

Figure 2-6 shows a graph of the number of oversight reviews conducted monthly between December 1997 and December 1998. They averaged about 115 reviews per month.

UDOT implemented an audit tracking file that began in December 1997 to document how many audits were performed and their status. No detailed records of the audits prior to December 1997 were kept.

UDOT's involvement consisted of weekly oversight audits performed to assure that the Contractor was following his own procedures in the design and that questions raised by UDOT and others were being fully responded to by the design team. Detailed reviews were limited to possibly less than 5% of what would normally be performed by an owner. **Figure 2-7** shows the extent of audits performed during the design process.

Figure 2-7. Design Quality Audits



Non-Conformance Issues. UDOT's Auditor reviewed the Wasatch audit records of the QC/QA procedures and then prepared a report on non-conformance issues. UDOT's Technical Support Manager then evaluated the significance of non-conformance issues. Major non-conformance findings that could affect the Award Fee were returned to Wasatch for response. Monthly audit results were considered in the Award Fee evaluation.

Some non-conformance issues were raised on non-critical issues such as failure to use the exact process of review specified in the DQMP. These issues were generally remedied by additional training. The stringent process established by Wasatch created several of its own non-critical and non-conformance findings. A more simplified process would have been acceptable contractually and may have avoided some of the non-conformance issues. However, once Wasatch adopted the plan, UDOT was obligated to enforce the process in the audits.

Approval Authority. The design-build process was intended to expedite the design process and permit construction to begin prior to having a complete set of project construction plans. Many I-15 Project design documents were released in phases to expedite the construction process.

As the design progressed, updated plans were released that showed the previously completed and added design details. There were instances where up to five or more releases were made on the same construction element. For example, foundation plans for a bridge structure were released for construction prior to completion of the superstructure design. Subsequently, separate plans for piers, pier caps, girders, and finally deck details were released. Because of this accelerated process requiring multiple releases of the same construction plans, it was critical to control release of documents for construction.

In order to control the release of documents, Wasatch instituted procedures for drawing approval documented in the DQMP. They included:

- All construction drawings or specifications were to be prepared under the direction of a licensed engineer.
- The Engineer of Record placed a seal on the design plans prior to submitting them for release.
- The Section Design Manager was responsible for conducting formal design review meetings at the 30%, 65%, 90%, and 100 % design levels.

Process

Once reviews are conducted and changes made to the documents, the designer placed his/her seal on the document and submitted it to the Section Design Manager. The Section Design Manager reviewed the documents and, if they were acceptable, sent them to the QA Manager.

The Design Quality Assurance Manager performed an audit of the QC process, then signed the documents and forwarded them to the Design Manager.

Once the Design Manager was satisfied that the documents were complete and that Wasatch had completed a constructability review, he/she signed the plans and released them to Wasatch. This approval was called an “Approve for Construction” (AFC). The Wasatch Construction Manager then approved the “Release for Construction” (RFC), and the documents were sent to the Construction Section Manager for use in the field.

A final QA review of the 100% package was done before submitting the plans to Wasatch for use in construction. It included checking that comments and issues have been addressed in the final plans, assuring completeness of plans, and verifying that QC checks were completed.

Formal Final Submittal

A final seven-day review for each section was performed at the end of the design by UDOT. To facilitate the final review process, Wasatch scheduled the 12 design section submittals one week apart with allowances made for Christmas and New Year’s Eve holidays. By contract UDOT agreed to complete a one-week review and return written comments to be followed by a subsequent Comment Resolution Meeting. The Design Group was then required to resubmit final corrections two weeks later. Because of

the many comments made for all sections, a final submittal was made at the end of the review period to ensure all issues were adequately addressed.

For the final review, each section averaged 200 comments. This was more than what Wasatch expected. About half of these comments were editorial with no additional design action needed. UDOT also commented on items that had not been commented on previously even though it was anticipated that only an assurance check would be performed to ensure that previous comments had been addressed.

For the final review submittal, the design-build team submitted one package weekly beginning the end of November 1998 for a total of twelve submittals, with the last one scheduled for mid-March 1999. A thirteenth package was intended as a “clean up” submittal at the end of the process to incorporate any comments that affected all of the submittals. After the final review, UDOT sent a final letter of design approval although the design was not to be formally accepted until after the final construction was completed and accepted.

DESIGN CHANGE PROCESS

The design change process was developed by Wasatch as part of their Design Quality Management Plan (DQMP) prepared according to contract requirements and ISO 9000 certification process. The procedures included detailed responsibilities and documentation requirements, including timeframes for review and approval.

There were two types of changes defined:

1. **Minor changes** included any change to the I-15 Project that did not conflict with the intended use, structural stability, or safety of the project.
2. **Major changes** were those that required input from the designer for the particular discipline (i.e., grading, drainage, or structures).

Origination

“Design Directives” approved by the Design Manager issued any needed design changes. Changes to the design could be the result of internal or external review comments and the resolution of technical issues that surfaced during the design and construction process. In all cases, changes were directed formally or through the documented actions of the Task Forces, as prescribed by the Quality Management Plan and QC/QA Plan.

Method

Changes to drawings or specifications already issued for construction were noted as revisions on the drawing/specification being altered. The changes to drawings and specifications that were issued for use were highlighted in bold text, circled, clouded, or emphasized by some other method. This called attention to the change to help assure that the user incorporated the modification during construction.

Any changes to the *I-15 Corridor Standard Specifications* required a change order approved by UDOT. Both the UDOT project manager and his deputy had authority to approve changes on behalf of UDOT.

Approval

Wasatch’s quality verification policies required that changes to the design be made and approved by the original designer. This referral to the original “Designer of Record” is common in most Agency QC/QA procedures, whether staff engineers or consultant engineers accomplished the design. The Wasatch team’s procedures for the production of design drawings also were the basis by which the Design Manager controlled the production and changing of design drawings. All “major” field design changes (those that needed referral back to the original designer) were processed through Wasatch and were subject to the approved QC/QA process.

LESSONS LEARNED

Value Engineering

The potential benefits of value engineering were limited on the project. Wasatch’s primary incentive was timely completion. Any modification to the proposed plan that resulted in requiring more time to construct was treated as a disincentive to use value engineering. The contract provided an incentive to use value engineering on alignment changes by agreeing to share any savings with the contractor on a 50/50 basis. Wasatch, in turn, agreed to share a portion of his savings with his design consultant (one-quarter of the savings). However, the subconsultants to the prime design team were not included in this

incentive. Also, because a lump sum contract was in place, the incentives for value engineering were limited to changes affecting the alignment.

Because the project was so schedule driven, the effects of value engineering were reduced in practice. Any value engineering change was evaluated on both the basis of the costs that could be saved and the impacts to the schedule any changes would require. Generally, changes resulting in an extension of the schedule were not implemented, even if there were cost savings associated with them. Delays to schedule were viewed as more critical than savings in costs. Since subconsultant design teams were not directly rewarded for value engineering efforts, they did not emphasize value engineering solutions.

The traditional value engineering process does not lend itself very well to Design/Build. By its nature design/build contracts provide flexibility to the contractor to make improvements in the design or changes that reduce the cost to the Contractor within the lump sum bid format. Therefore there is less incentive to save the owner costs normally associated with a more traditional contract form. The focus of the Contractor team is on ways to save time and costs in executing the work called for under the lump sum contract while still meeting the contractual requirements.

Development of Standards and Plans

Wasatch had thought that they could use many of UDOT's standard details in their design, but discovered that many of the details they wanted to use had either not been developed by UDOT or Wasatch wanted to use a different detail. Wasatch subsequently developed the standards specifications and plans used by all of the designers in completing the plan sets. More than 350 standard plans were developed for commonly used details of the construction. The standards presented the process and quality standards intended for each plan set to provide uniformity in design and assure that similar situations were treated the same way for ease in construction. Unfortunately, the standards were completed late in the process, after many of the designs had already started. This resulted in many changes to those plans that had been created beforehand. This could have been avoided or reduced had UDOT or Wasatch recognized the need to develop the standards and waited until the standards had been completed before beginning the design.

Wasatch indicated that they probably could have saved some time and costs had they concentrated early in the project on development of these design standards and plans. This would have necessitated some delay in the start of design, and Wasatch had elected to begin design as soon as they could and make the changes once the design standards were fully developed. This did not seriously affect the schedule and Wasatch still completed the design ahead of their planned schedule, but it did result in some reworking of the plans.

Performance vs. Prescriptive Specifications

UDOT prepared several project-specific performance specifications. They also referenced their standard specifications, which are prescriptive, for several items not covered by the performance specifications. Wasatch had some difficulty in using this mixture of specifications because they felt that the prescriptive specifications limited their ability to provide innovative solutions to resolve problems. They much preferred the performance specifications because these results-oriented specifications permitted Wasatch to accomplish the design or construction in a manner that best suited the preferred equipment, material or methods. Wasatch recommended that an owner consider providing as much flexibility to the Contractor as possible to permit him to use innovative means and methods to complete his work. Refer to Chapter 5 on performance specifications for a more thorough discussion of this topic.

Constructability Reviews

UDOT had expectations that they would benefit from use of constructability reviews during the design process through significant improvements in the designs. UDOT found that this did not occur as often as they expected. Also, subcontractor designers were often not included in these types of reviews, lessening their potential benefit.

Engineer of Record

UDOT expressed some concern that the Engineers of Record who prepared, stamped, and sealed the drawings were not retained through the construction phase of the project, leaving the project after design was complete. The result is that field changes were reviewed by the construction support group and changes made without being able to consult with the Engineer of Record who prepared the original drawings. One recommendation that UDOT made was that on future contracts the Engineer of Record be required to remain on the project in a construction support role through the construction phase.

Accelerated Construction Schedules

One of the major conflicts noticed between the designer and the construction personnel was the use of accelerated construction schedules by Wasatch. Often, Wasatch required early submittals when the design had not been developed completely enough for the designers to be confident about what the designs required. In the case of the retaining walls, there was difficulty in releasing early construction items to Wasatch in the desired time frame. This placed all of the retaining wall designs on the critical path schedule and required that some walls be modified in the field after some problems arose with walls constructed in the wrong location. Fortunately, this did not prove to have a significant negative impact on the project.

The design teams tried to standardize many of the wall details and designs to attempt to alleviate some of this problem but were not able to resolve all of them. Universally, the designers indicated they would have preferred more time to more completely develop the retaining wall designs prior to releasing them to the contractor.

Consolidated Office Location – “Hub”

Having all of the design-build team located in the same location was vital in meeting project schedule. Generally, the consensus between UDOT and Wasatch was that there would have been no other way to accomplish this project on schedule. Time was not wasted transmitting faxes, commuting to meetings, trading telephone calls, etc., since everyone was connected electronically. With UDOT, Wasatch, and the design team all located within the same location, it was very easy and efficient to address questions and issues. Wasatch stated that this should be a requirement of the contract and that a design-build contractor should plan for expandability of office space. It was also suggested that having all the subconsultant design firms in the same offices would have improved coordination even further.

Advantage of Task Force Meetings

It helped to have a forum where UDOT could “speak up” as a design issue was encountered so it could be dealt with before it became a problem. Wasatch acknowledged that having the UDOT’s acceptance/approval as things went along was helpful. The Task Force meeting process facilitated this interaction.

Audits

It is important that an audit tracking system be set up at the beginning of the design-build process. It took UDOT several months to set up their tracking system. For approximately six months of design, there was no detailed tracking of records of the audit process kept by UDOT. It was suggested that the owner clearly define what should be checked at the beginning of the design-build process. This would provide

an effective baseline for establishment of the Contractor's process. On the I-15 Project, Wasatch completed detailed reviews of all work products and not just those being formally submitted to UDOT or actually used in the field. Some effort could have been reduced had Wasatch adopted a different audit policy.

Wasatch's QC/QA program was more extensive than required by contract, especially on earlier submittals when full QC/QA checks were completed when not really needed. UDOT only required complete reviews for 50% and 100% design completion. Wasatch required completing reviews at 30%, 65%, 90% and 100%. The general consensus was that they would probably not perform as detailed of a program for future projects.

Reviews

The contract provided for a 7-day turn around by UDOT on the final plan submittal. This time frame was not sufficient. More time should be provided for this process.

The Task Force meetings and weekly Comment Resolution Meetings were a significant benefit to the project's success. They allowed for multiple agency involvement during development of the design and resulted in fewer comments and changes at later stages.

Overall, the level of oversight and emphasis placed on QC/QA procedures and processes was impressive with all three parties (Wasatch Constructors, DeLeuw/Sverdrup and UDOT) continuously stressing the importance of the QC/QA program.

Staggered submittals should have been required in the contract. Wasatch worked with the I-15 UDOT Team on this, but were not required to do this by contract. However, for this project it worked out.

Because of the magnitude of the number of bridges, UDOT felt there should have been more people involved on UDOT's part to review the bridges.

Processes for effectively coordinating field changes need to be established early and be in place at the beginning of the project.

Impacts of Time-Driven Schedules

Schedule was the major driving force in design and seemed to limit much of the design innovation. Although there may have been a better way to accomplish some elements, they were not considered if it meant compromising time limits. This is largely due to the fact that the Award Fee was primarily structured around meeting the schedule.

Owner Involvement

UDOT was extremely committed to the I-15 Project and the design-build process. They actively attended all meetings and participated throughout. UDOT was very proactive thinking out-of-the-box and coordinating with the on-site staff. This helped expedite the design schedule and issues resolution.

Over-the-Shoulder Reviews

"Over-the-shoulder" reviews proved to be necessary to keep the project on schedule. "Over-the-shoulder" reviews permitted UDOT to become much more familiar with the design as it was developed and expedited the review process, since the reviewers already were familiar with many of the design concepts used. Wasatch also supported this process since it gave them early feedback in the design process that UDOT would agree with the designs used, thus avoiding many costly redesign delays.

CHAPTER THREE: QUALITY ASSURANCE/QUALITY CONTROL (QC/QA) PROGRAM

This chapter describes the QC/QA process utilized on the I-15 Project. Traditionally a Contractor working on a construction project for a DOT has only had to be concerned with having the Owner conduct inspections and tests and accept or reject their work. On this design-build project, the Contractor was required to provide both QC and QA for their own work, not only in the construction phase but also in the design phase--an area not normally involving a construction contractor. This chapter discusses the programs instituted and how they were modified to complete the I-15 Project.

THE I-15 QA/QC PROCESS

There were many factors inherent in the I-15 Project design-build process that required a unique approach to QC/QA. One of the most significant differences from a normal QC/QA program is that the Contractor was required to perform the roles traditionally reserved to the Owner. This included quality control activities including inspection and testing of completed work and quality assurance reviews of the design and construction. The Owner only intended to perform “over-the-shoulder” reviews, oversight, and independent verification reviews.

As part of the I-15 Project Wasatch was required to develop a Quality Management Plan that addressed Design, Construction, and Maintenance. Typically, design is completed, reviewed and approved by an Owner prior to the start of construction. During construction the Owner traditionally performs both QC and QA roles. Maintenance is typically the responsibility of the Owner after project acceptance. On the I-15 Project, these roles were transferred to the Contractor.

Wasatch was required by contract to develop a Quality Management Plan and QC/QA Plan for the project and develop a plan that could be certified using standards established by ISO 9001, an international standard for quality. These were to be documented in a series of progressively detailed manuals that defined the project’s quality program. These manuals included:

- Quality Management Plan
- Quality Control/Quality Assurance Plan, Part One: Quality System Standards
- Quality Control/Quality Assurance Plan Part Two and Three:
- Design, Construction and Maintenance & Materials and Equipment
 - Volume I, Design Quality Management Plan (DQMP)
 - Volume II, Construction Quality Management Plan (CQMP)
 - Volume III, Maintenance Quality Management Plan (MQMP)

Key definitions included in the Quality Management Plan (QMP) included:

- ***Quality Assurance.*** A program of planned policies, procedures, detailed responsibilities and systematic actions necessary to provide adequate confidence that a structure, facility, system or component will perform satisfactorily in service.
- ***Quality Control.*** The acts of examining, witnessing, inspection, checking and testing of in-process or completed design work, including in progress plan sheets, studies and reports to determine conformity with contract requirements.

Two Quality Management Plans, DQMP, and CQMP were certified under ISO 9001 within about one year after award of the contract. The MQMP was not required until six months prior to the completion of

the construction, and only if UDOT elected to award the maintenance after construction portions of the contract. UDOT elected to not award this portion of the work so the MQMP was never prepared.

DESIGN QA/QC – WASATCH

The Design Quality Management Plan (DQMP) was developed to address the design phase of the project. It was prepared for Wasatch by their subcontractor Sverdrup/DeLeuw, a joint venture of Sverdrup Civil (now Jacobs Engineering) and DeLeuw Cather (now Parsons Transportation Group). Implementation of this DQMP was the responsibility of the Sverdrup/DeLeuw team as part of their design responsibilities. **Figure 3-1** shows a summary level of the organization used by Wasatch. **Figure 3-2** presents a more detailed organization chart.

Roles and Responsibilities in the DQMP

Principal On-Site. At the top of the Wasatch organization chart was the Principal On-Site, who was responsible for planning, administering, and authorizing the use of all Wasatch resources assigned to the I-15 Project. This person was directly responsible for the completion of all contract requirements and regularly reported to the joint venture control board (comprising representatives from each of the joint venture contractors and their design consultant team). The joint venture control board in turn reported to the UDOT I-15 Management Team.

Project Manager. The Project Manager reported directly to the Principal On-Site and was responsible for all design, construction, maintenance, and quality control on the project.

Quality Assurance Manager. The Quality Assurance Manager also reported directly to the Principal On-Site. The Quality Assurance Manager was a Wasatch employee who utilized design consultant staff to perform the Quality Assurance on design, construction, and maintenance.

Design Quality Assurance Manager. The Design Quality Assurance Manager (DQAM) reported directly to the Quality Assurance Manager. The DQAM audited all work produced by the Wasatch design team. The DQAM primarily checked to see that the QC process has been adhered to and spot-checked actual calculations and other design criteria to confirm that quality control checks had been completed. The DQAM performed more than 15,000 audits. No design drawings were given to the field personnel without the DQAM's review and approval. Specific duties of the DQAM included:

- Establishing and implementing the QC/QA Program and Plan
- Overall coordination and direction of the Design QC/QA program
- Preparing, coordinating, distributing and maintaining QA policies, procedures, standards and guidelines
- Audits of design QC/QA activities
- Certification of all design documents prior to submittal to the Contractor
- Providing training to project personnel on QC/QA requirements
- Establishing, implementing and the maintenance of ISO Q9001 procedures for certification and registration for the life of the project

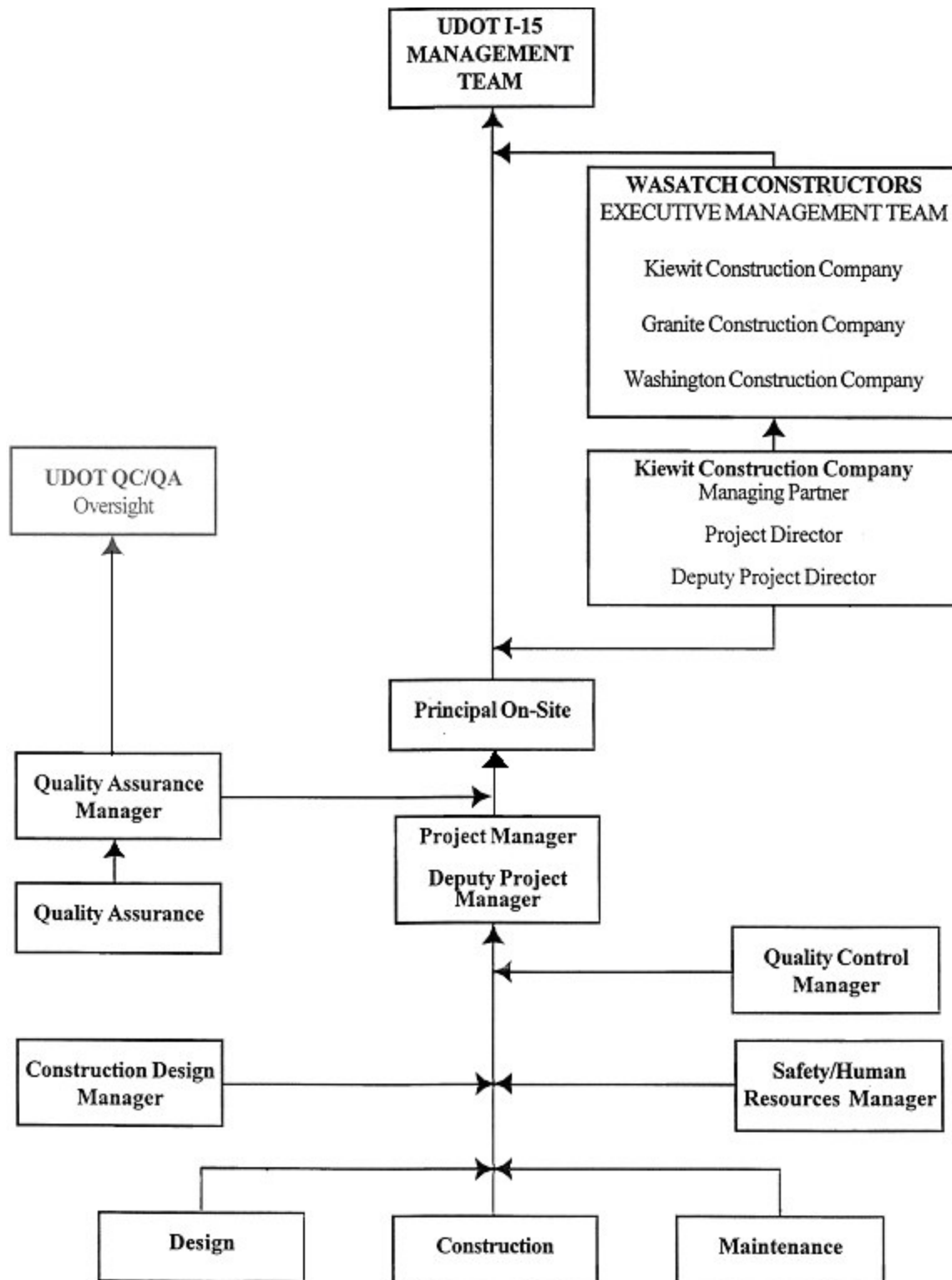


Figure 3-1. UDOT I-15 Management Team

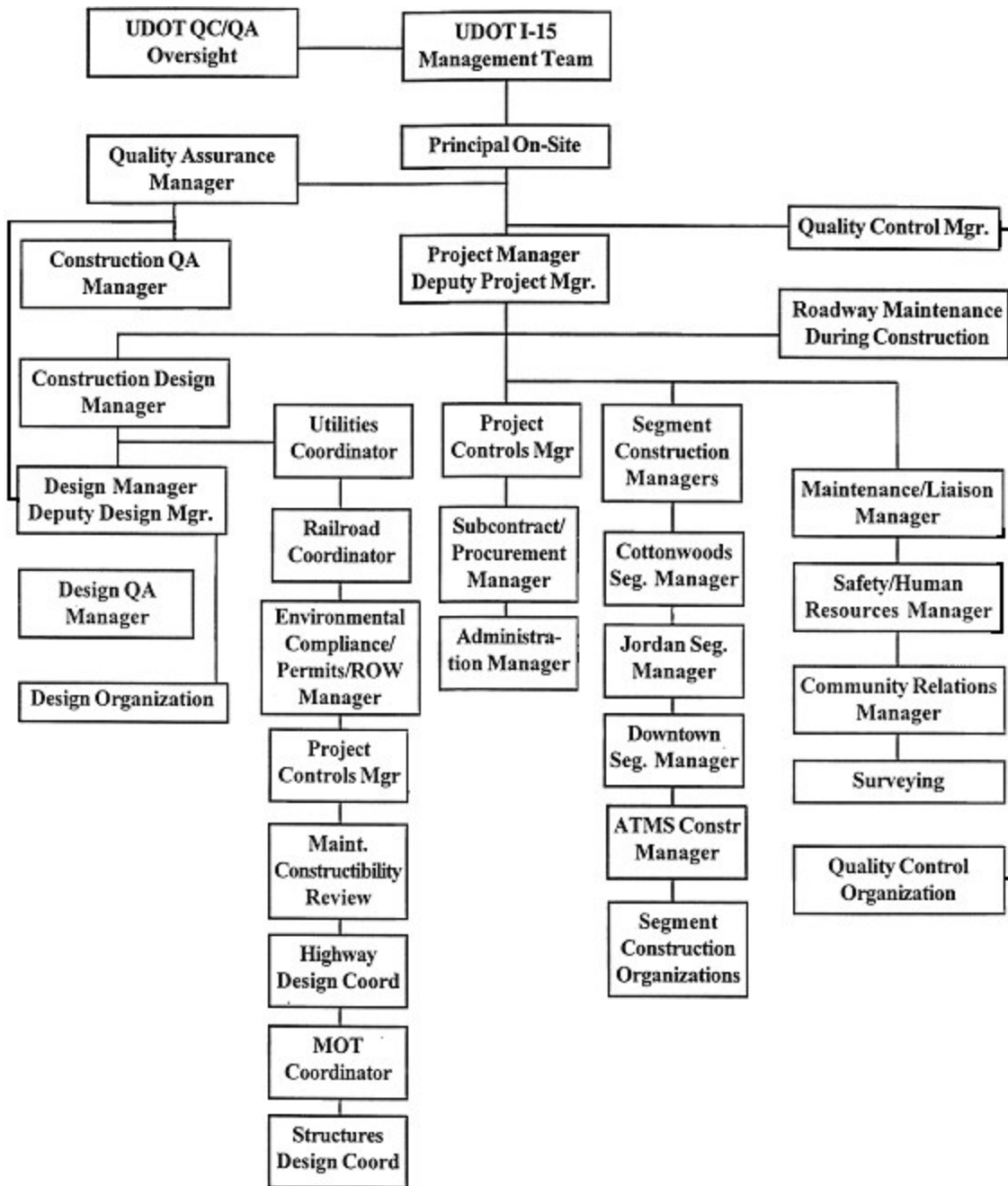


Figure 3-2. UDOT I-15 Management Team (cont.)

Construction Design Manager. Quality Control of design was completed within the production process. The Construction Design Manager was a Wasatch employee who served as the point of contact with the Design Manager of the Sverdrup/DeLeuw joint venture. He also managed constructability reviews at various levels of the design process.

Design Manager. The Design Manager was a Sverdrup/DeLeuw employee who served as the point of contact for the Wasatch Construction Design Manager. This person managed the Sverdrup/DeLeuw design effort and reported to both the Construction Design Manager and the Sverdrup/DeLeuw joint venture control board. Among numerous duties was the budgeting of the QC/QA effort for design work.

Section Design Manager/QC Document Coordinator. QC was part of the responsibilities of all subordinate design staff. The key position in this group was the Section Design Manager, who also served as the QC Document Coordinator. The Coordinator duties included:

- Being fully knowledgeable of the Design QC/QA procedures
- Responsible for the completion of all QC functions within the Section
- Perform day-to-day surveillance of project activities
- Provide orientation to design team personnel regarding QC/QA requirements
- Maintain current listing of audit dates, results, and the status of documents under review
- Provide status reports to the DQAM as required
- Control all plan sets and QC documents until delivered to final document control

A standard design QC procedure was utilized which involved checking, back checking, and verification of design drawings and documents. A formal procedure involved forms and colored highlighting and was uniformly utilized by Sverdrup/DeLeuw design staff and their subconsultants.

DESIGN QA/QC – UDOT

Within UDOT, the I-15 Project was managed by the UDOT I-15 Management Team, reporting directly to the Utah Department of Transportation Executive Director. The Management Team was lead by a Project Director, who worked closely with a Public Information Group and a Deputy Project Director. The Deputy Project Director managed Contract Administration, Construction Oversight, Railroad, Right-of-Way & Utilities, Quality Oversight, and Technical Support. This organization is show on **Figure 3-3**.

The organization for Technical Support, Construction Oversight and Quality Oversight are illustrated in **Figures 3-4, 3-5, and 3-6**.

Technical Support

The Technical Support Manager was responsible for Design Quality Oversight, Environmental Oversight, and Engineering Support. Engineering Support was subdivided into Roadway, Structural, and Geotechnical Oversight.

The UDOT Technical Support Group provided oversight of the Wasatch Design QC/QA process by performing “over-the-shoulder” reviews and regularly reviewing the QA process documentation to ensure compliance. The group also provided technical support to all UDOT field staff, as needed.

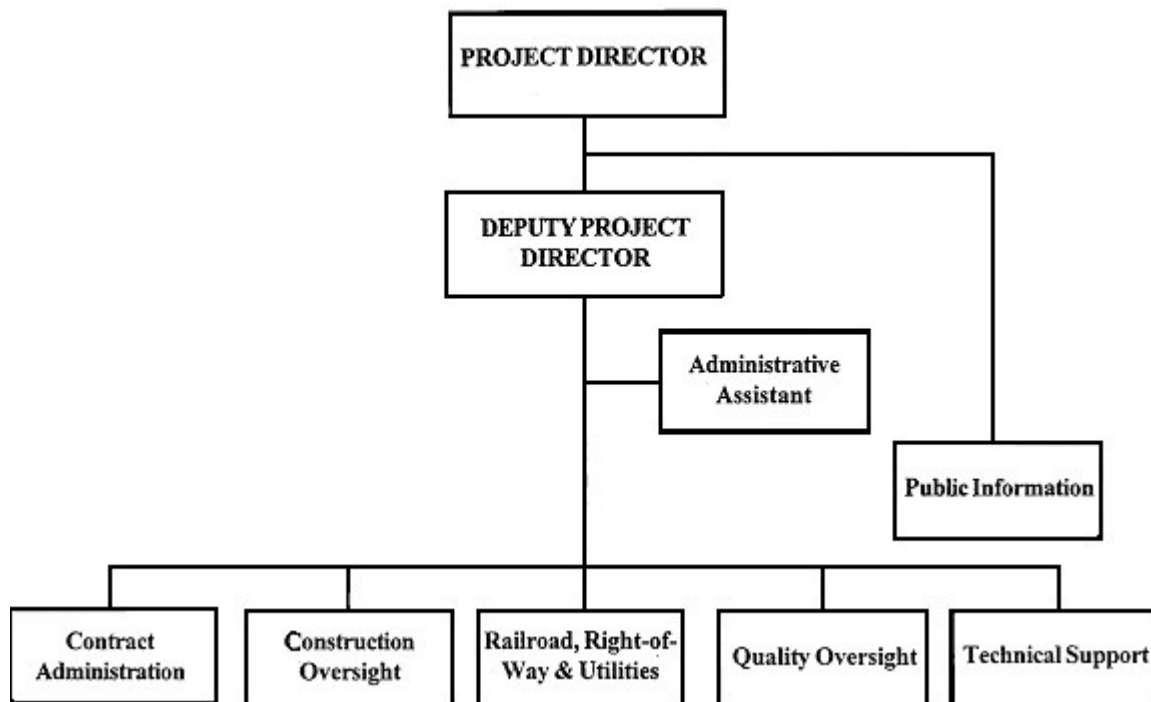


Figure 3-3. I-15 Reconstruction UDOT Project Organization

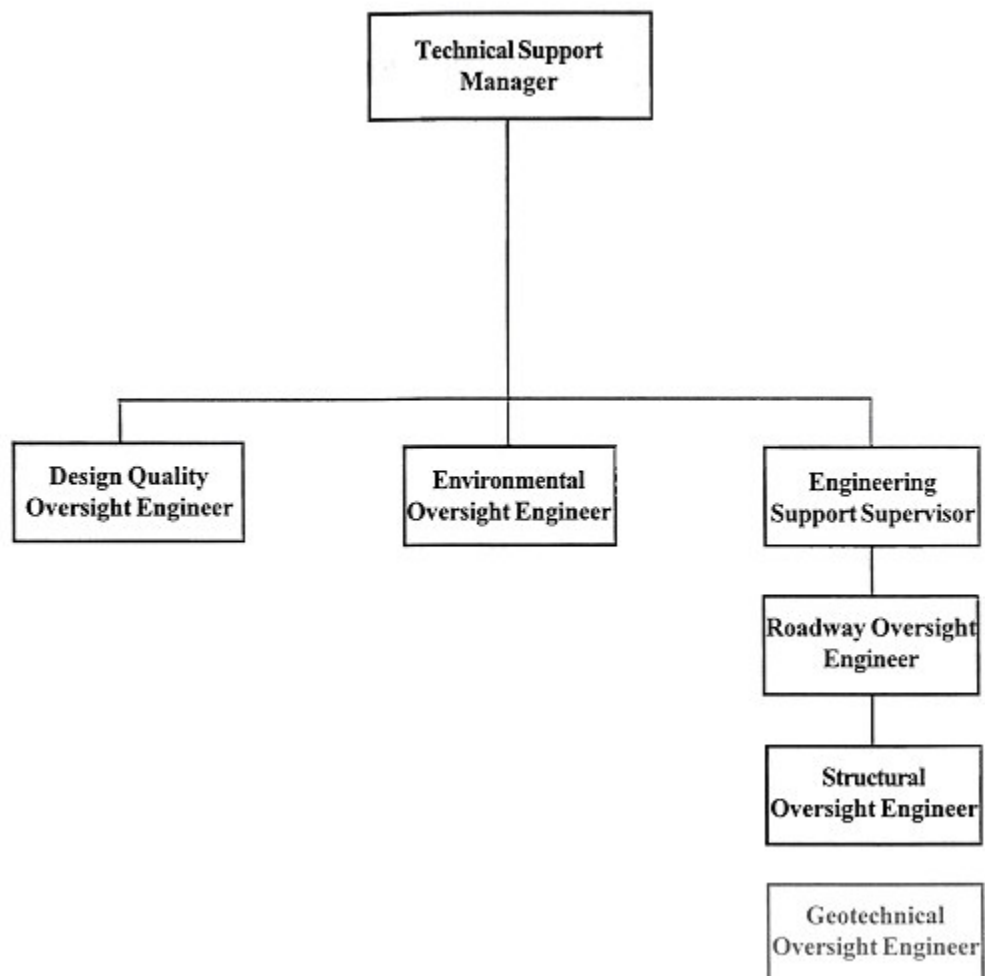


Figure 3-4. UDOT Technical Support

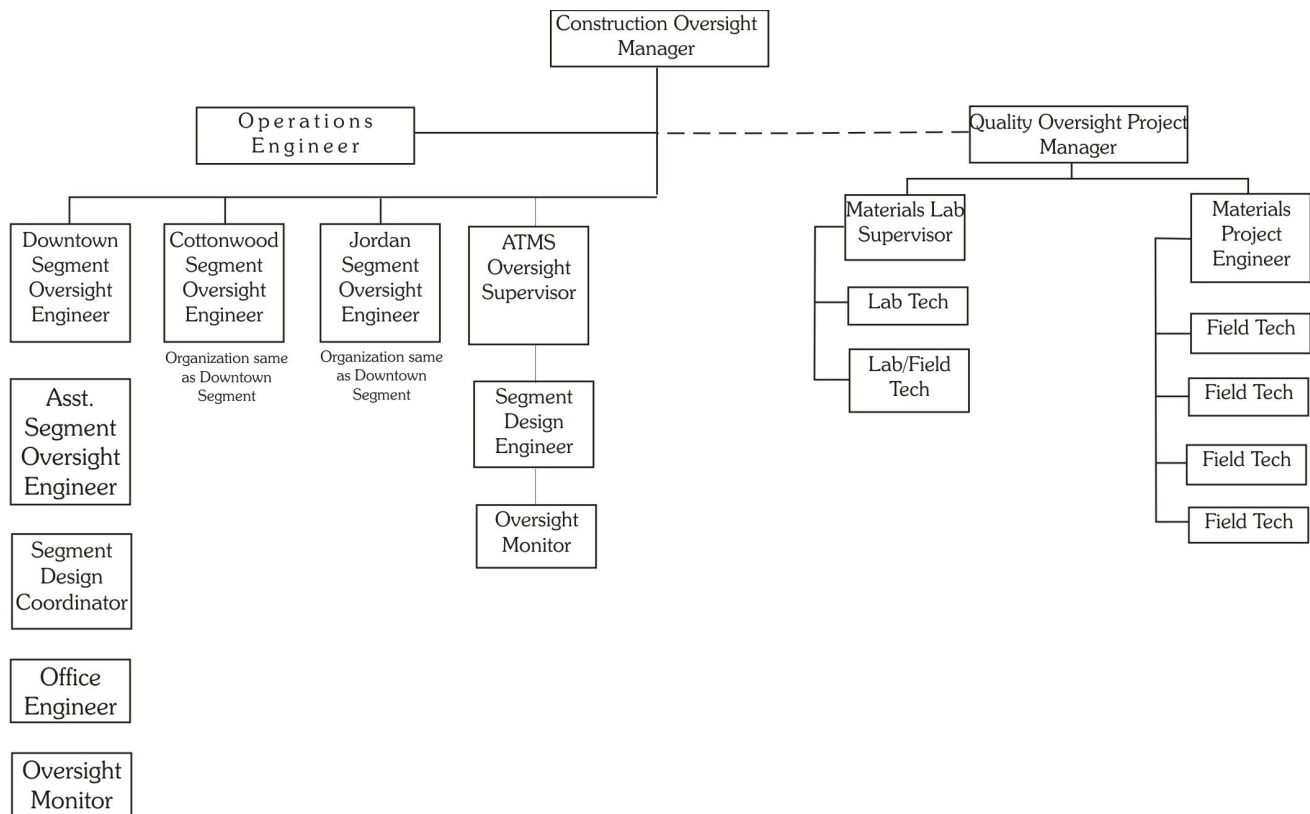


Figure 3-5. UDOT Construction & Quality Oversight

Roadway, Structural and Geotechnical Oversight Engineers performed “over the shoulder” reviews on a continuous basis. The Contractor conducted his own formal reviews at 30%, 60% and 90% complete stages. Over the shoulder reviews were done with the Wasatch designers as an “in process” activity, with very little disruption to the design sequence. They were conducted in conjunction with the weekly Task Force meeting, where design concepts were discussed. The Design Quality Oversight Engineer conducted end product reviews. Oversight Engineers also reviewed Field Design Modifications (FDM) for compliance with design objectives. This was done through multiple weekly meetings with the Wasatch group. The UDOT Segment Staff also attended meetings regarding FDM issues when they were of interest to the individual Segment. The flow chart for Field Design Modifications is shown on **Figures 3-6 and 3-7**.

CONSTRUCTION QC/QA

The Construction Quality Management Plan (CQMP) outlined the Wasatch approach to QC/QA used during construction. Wasatch managers defined QA as surveillance and audit functions, while QC was defined as end process control and acceptance testing. The Construction QC and QA managers had their own staff and operated independently of each other.

Construction QC/QA was organized as follows:

- QC by Wasatch with their own employees
- QA by Wasatch (provided primarily by Sverdrup/DeLeuw staff)
- Construction Oversight by UDOT (Region Two and the Central Lab), including testing, inspection and audits
- Independent testing by ATSER, a private consulting firm employed by UDOT

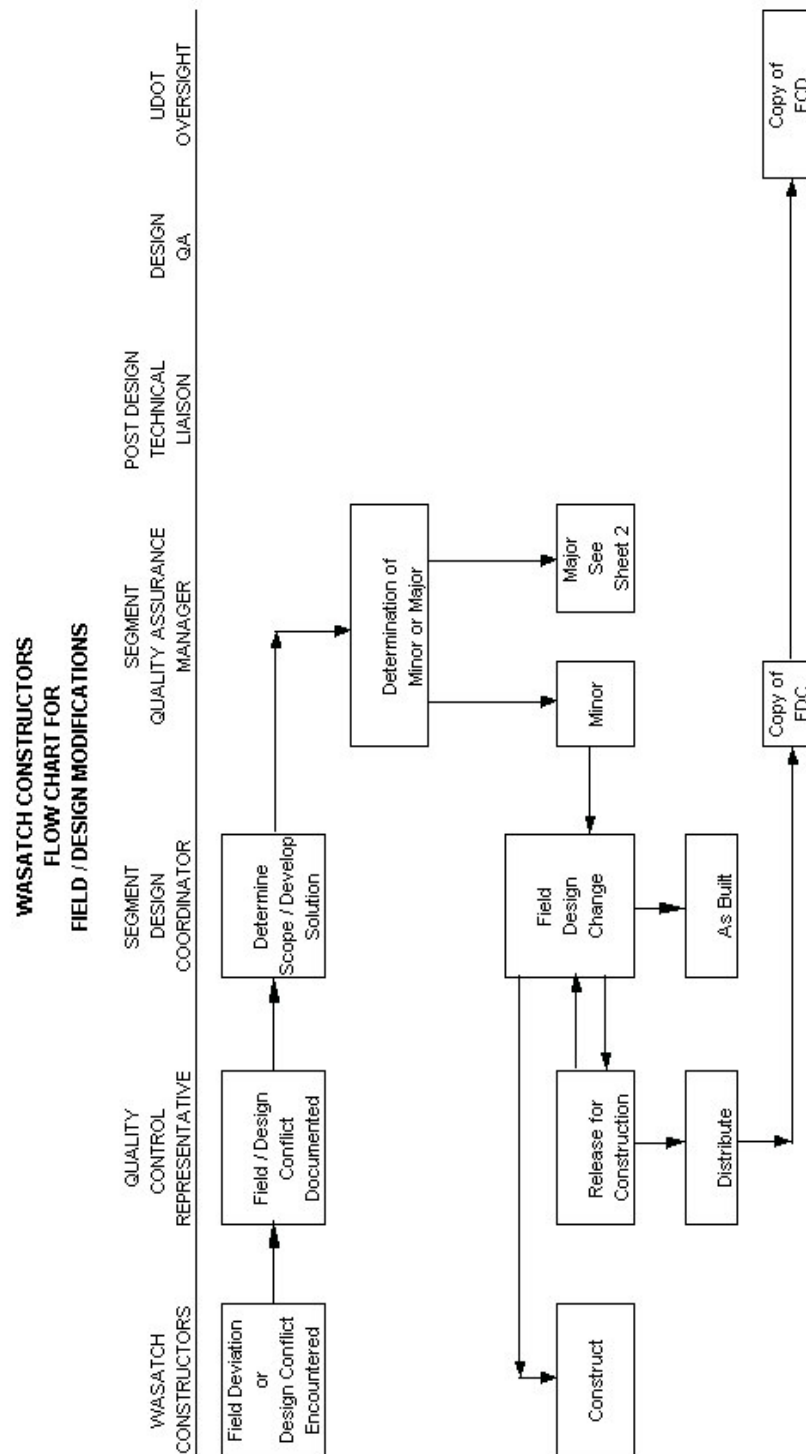
Quality Assurance Roles and Responsibilities

Wasatch’s Quality Assurance Organization is shown on **Figure 3-8**.

Project Quality Assurance Manager. The Project QA Manager (PQAM) administered Quality Assurance—the auditing and surveillance element of the Wasatch QC/QA effort.

Construction Quality Assurance Manager. The Construction Quality Assurance Manager (CQAM) reported directly to the PQAM. The CQAM supervised the Assurance Inspection and Quality Assurance Testing and was responsible for ensuring that the program of testing and inspection was adequate to validate Contractor Acceptance Testing (CAT). The CQAM also served as the Maintenance QA Manager (MQAM). The CQAM’s staff was composed of Sverdrup/De Leuw employees. The CQAM’s duties include:

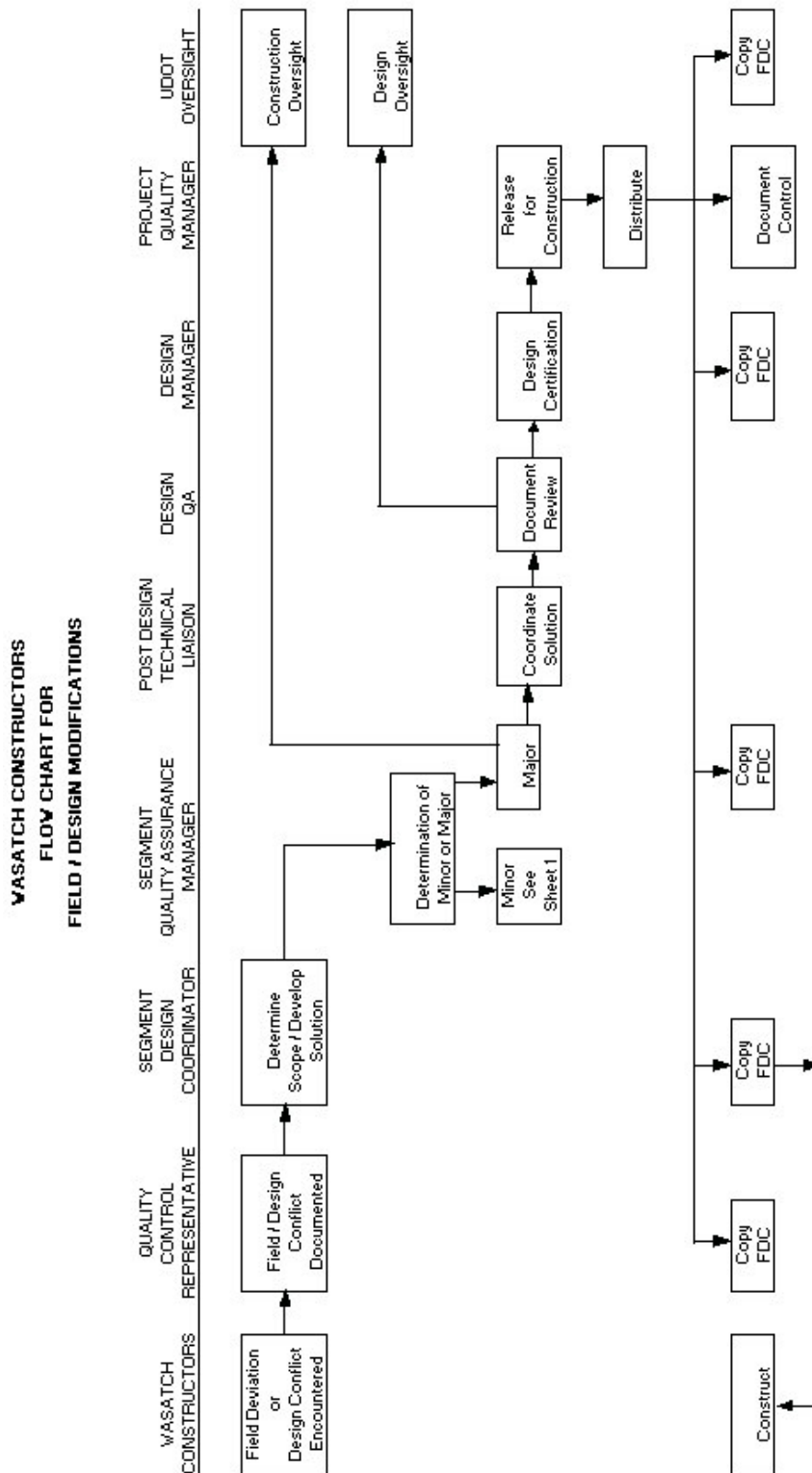
- Establishing and implementing a Construction QA Program and plan
- Preparing, coordinating, distributing and maintaining QA policies, procedures and guidelines
- Developing QA inspection and test procedures, in cooperation with UDOT and the Quality Control Department, for use on the I-15 project
- Assuring that QA personnel requiring certification are properly certified and shall maintain a file of pertinent information concerning certifications
- Providing a signed certification stating that the Construction Quality Management Plan and all of the measures and procedures provided therein are functioning properly and are being followed



Responsibility of Entities

WASATCH Constructors - Construct from approved and Released for Construction plans and documents including designer clarifications and verification.
 Field Design Coordinator - Interface with Segment QC Representative and Segment QA Manager to propose solutions to conflicts, acquire and document all changes. Provide As Builts.
 QC Field Representative - Inspect and approve Construction, documents field/design conflicts and resolution. Releases FDC for construction and distributes change documents.
 Segment Quality Assurance Manager - Determines "minor" versus "major" changes; authorize FDC for "minor" change.
 Post Design Technical Liaison - Provide Solutions to Major Changes. May be in the form of answers to Request For Information or Revised Plans and Special Provisions.
 UDOT Oversight - Review Field Design Changes and Oversight of corrective action.

Figure 3-6. Wasatch Constructors Flow Chart for Field/Design Modifications



Responsibility of Entities

WASATCH Constructors - Construct from approved and Released for Construction plans and documents including designer clarifications and verification.
 Field Design Coordinator - Interface with Segment QC Representative and Segment QA Manager to proposed solutions to conflicts, acquire and document all changes. Provide As Builts.
 QC Field Representative - Inspect and approve Construction, documents field design conflicts and resolution. Releases FDC for construction and distributes change documents.
 Segment Quality Assurance Manager - Determines "minor" versus "major" changes; authorize FDC for "minor" change.
 Post Design Technical Liaison - Provide Solutions to Major Changes. May be in the form of answers to Request For Information or Revised Plans and Special Provisions.

Figure 3-7. Wasatch Constructors Flow Chart for Field/Design Modifications (cont.)

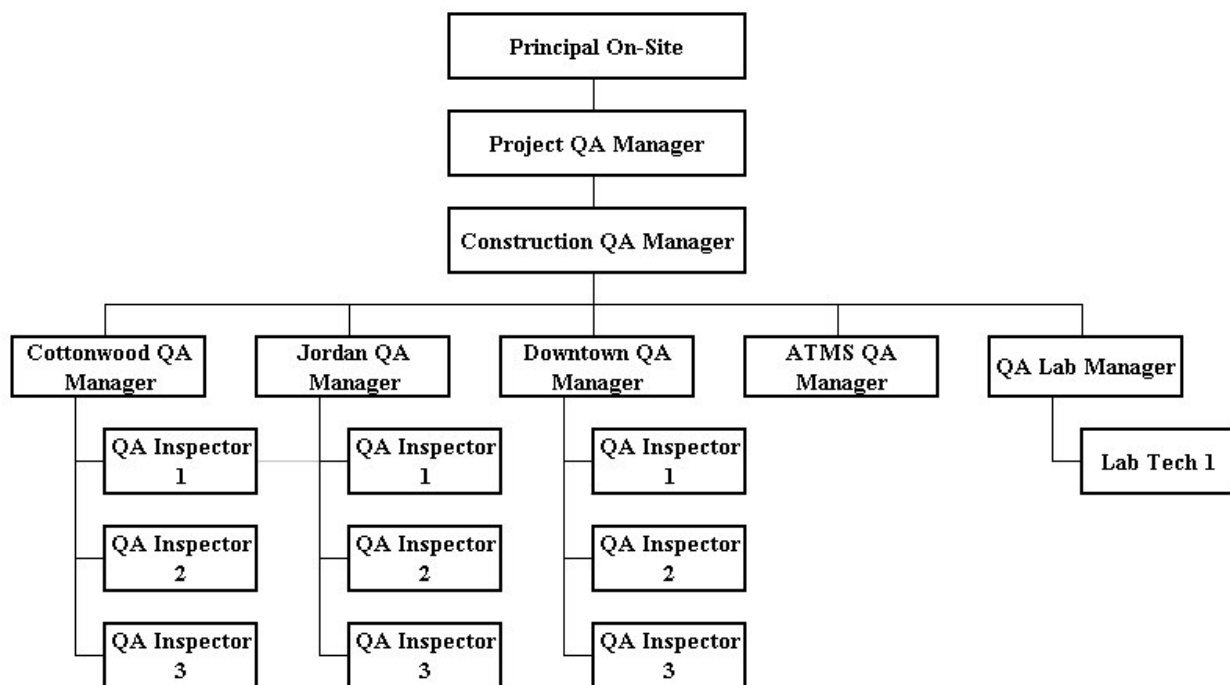


Figure 3-8. Wasatch Constructors Quality Assurance Organization

Segment Construction Quality Assurance Managers. Five Segment Construction Quality Assurance Managers (SCQAM) reported directly to the CQAM and were responsible for the three construction segments, pavement and the ATMS. Each SCQAM was assigned an inspector, tester and auditor, with the exception of the ATMS SCQAM, who was assigned only an auditor.

Quality Assurance Process

Quality Assurance was provided by audit of documents, inspection and testing, and by the statistical analysis of the resulting data and data provided by the QC group.

Document tracking was facilitated with the use of Expedition, a proprietary tracking software, which was linked to Primavera P3, a proprietary scheduling software. All documents were linked to one of the approximately 6,500 activity codes in the scheduling program and to the appropriate inspector or tester.

The Quality Assurance Group produced monthly QA audit reports that:

- Documented the qualifications of QC inspectors and the adequacy of the QC staff for future assignments
- Produced a statistical evaluation of QC testing that correlated the QC test results to QA test results
- Certified that all construction work performed during the preceding month was in conformance with the contract documents. Work not in conformance was tracked through a Nonconformance Report (NCR).

Quality Control Roles and Responsibilities

Wasatch's Quality Control Organization is shown on **Figure 3-9**.

Project Quality Control Manager. The Project QC Manager (PQCM) reported directly to the Project Manager, the number-two person in the Wasatch Organization. The QC Manager's staff consisted of Wasatch employees.

The Project Quality Control Manager (PQCM) had no other responsibility than "quality"-related aspects of the project and the implementation of ISO 9003 standards. At one time there was a staff of approximately 120 technicians and professionals. Specific functions of the PQCM included:

- Overall responsibility for the acceptance of the work
- Establishment and implementation of a QC Program and Plan
- Overall coordination and direction of the QC program
- Preparation, coordination, distribution, and maintenance of QC policies, procedures, standards and guidelines
- Providing support services to the I-15 Project QC organization to assure the quality of work essential to the QC goals of the project
- Maintenance and retention of qualification, orientation, training, and certification records of QC staff
- Certification that all materials and labor on the project had been inspected by the QC group and that all work, except as specifically noted in the certification, conformed to the requirements of the contract

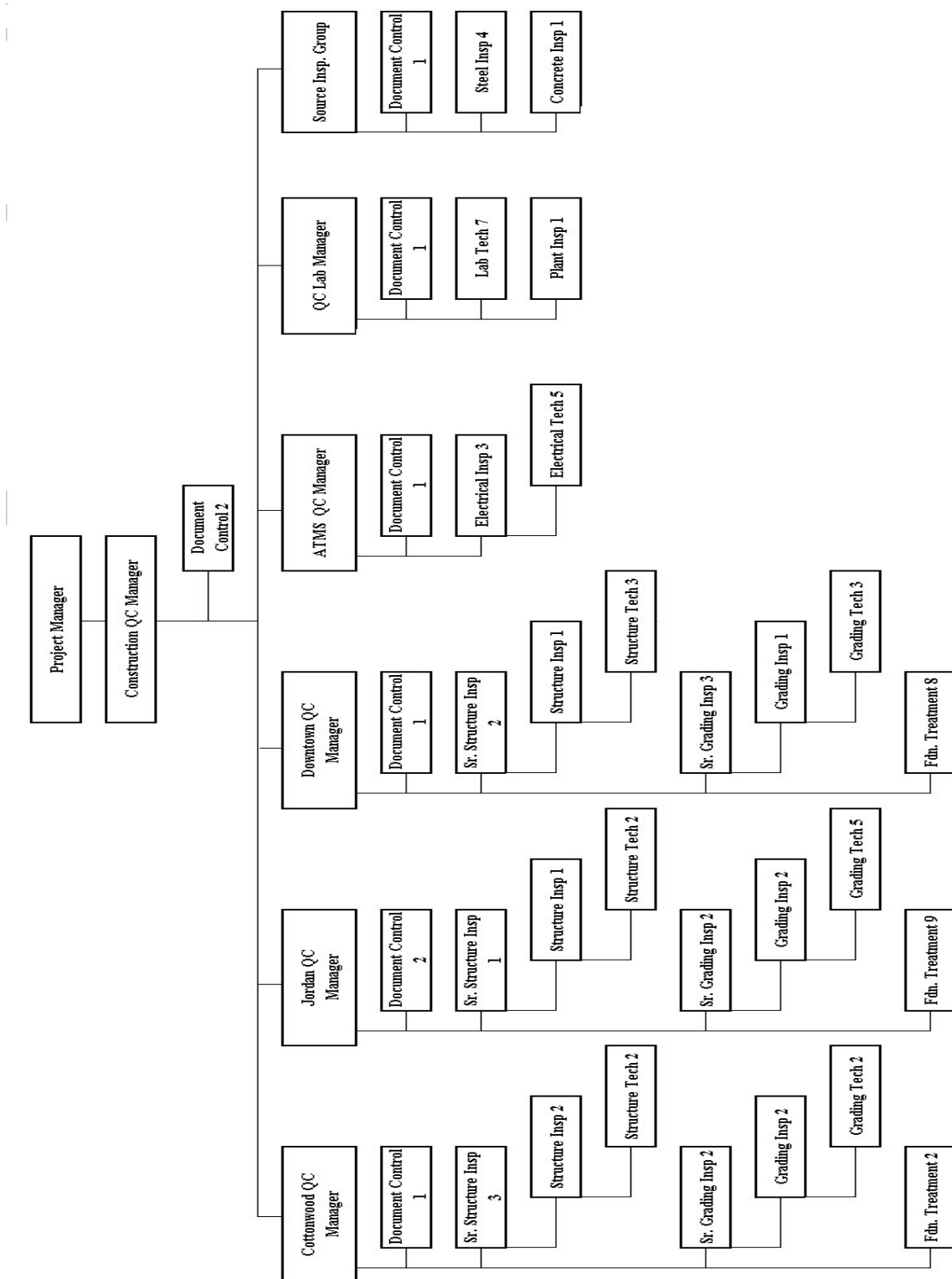


Figure 3-9. Wasatch Constructors Quality Control Organization

QC Managers. Five QC Managers reported directly to the PQCM, one for each of the three segments of the project, one for the overall pavement, which was designated as its own segment in the second year, and one for the Automatic Traffic Management System (ATMS). Each group has 15 to 25 technicians. In addition, a number of off-site inspectors were employed by Wasatch to monitor fabrication and production sites, some located out of state. A Project Laboratory employed approximately 10 testing technicians. There were also service agreements with outside testing laboratories for specialty testing.

Testing frequencies in the field for QC were the minimum requirements stated for “normal” testing procedures in the UDOT Minimum Sampling and Testing Requirements procedures. QC testing was the point of acceptance in the Wasatch QMP, with QA utilized for verification only.

Wasatch Testing Laboratory

In order for Wasatch to perform their QC/QA role, they were required either to establish a certified laboratory to conduct the required material tests or to hire an independent laboratory. Wasatch chose to set up its own testing laboratory to perform all but very specialized tests. The contract required that the laboratory and personnel be certified by AASHTO to perform the testing work.

It took almost one full year to obtain all the necessary certifications for this new laboratory. Most, if not all of this time, was required to complete the required reviews and certifications and could not be shortened. Until Wasatch could achieve the appropriate certifications, UDOT performed some of the tests, assisted Wasatch in certifying their staff and calibrating equipment, and assisted in other ways to assure that adequate testing was performed by a certified laboratory while Wasatch’s laboratory was being certified.

Wasatch indicated that it was important to have its own laboratory--to keep up with the construction schedule and to have control, rather than having to rely on a third party laboratory.

Construction Oversight-UDOT

UDOT’s Quality Oversight Group developed its own quality oversight procedures manual for the I-15 Project. The manual and actual field procedures dovetailed into the Wasatch Quality Management Plan.

Senior management at UDOT provided substantial support to the I-15 Team. The UDOT Executive Director, Engineer for Construction & Materials, I-15 Construction Oversight Manager, and I-15 Project Director met regularly to discuss issues.

Construction Oversight Manager. The Construction Oversight Group within the I-15 Team was led by the Construction Oversight Manager. He was responsible for each of four segments of the project: the Downtown Segment, the Cottonwood Segment, the Jordan Segment, and the Automated Traffic Management System (ATMS).

Segment Oversight Engineers. An Oversight Engineer who had comparable background and training to a UDOT Resident Engineer led construction oversight of each of the segments. The Oversight Engineer communicated with the Segment QC Manager for the Wasatch team, and had a staff of four including an Assistant Segment Oversight Engineer, a Segment Design Coordinator, Office Engineer, and Oversight Monitor. UDOT I-15 Team field representatives provided “hands-on” observations as a check on Wasatch’s own QC/QA effort. While the Monitor reviewed field practices of the Wasatch QC/QA staff,

the Design Coordinator reviewed field changes or field design memos (FDM) for compliance with design-build standards.

Construction QA - ATSER

UDOT contracted with ATSER, a private engineering consulting firm, to perform the verification testing as part of UDOT's independent assurance testing, overseen by UDOT I-15 Construction Oversight Manager. UDOT used their regional laboratory to monitor the testing procedures and calibrate equipment used by Wasatch and to check certification of technicians used in testing. ATSER conducted all verifications inspections and tests for UDOT. Their inspection and testing was both self directed and directed by UDOT staff.

ATSER's Project Manager was responsible for both laboratory testing and inspection services. Lab work was performed under the direction of a Lab Supervisor who had two technicians. A Project Engineer managed the inspection work with four field technicians.

ATSER provided monthly reports to UDOT that statistically compared their inspection and testing results to those of the Wasatch. In providing these services, ATSER verified this element of the over all I-15 project QC/QA plan. Their role was intended to meet the federal requirement that the Owner completed an independent verification of the quality.

CHANGES TO QC/QA ORGANIZATION

UDOT modified the requirements for inspector certifications early in the construction process because there were not enough sufficiently qualified and certified inspectors available for Wasatch to hire. Initially UDOT was requiring Level IV certification by NICET. Over time this requirement was modified to accept Level II certification for the same positions. UDOT anticipated that this may be a problem prior to award of the contract but decided to proceed with the expectation that inspectors would become certified at higher levels during the project.

The lack of a large local pool of available certified inspectors was a problem for Wasatch throughout the construction period and was never fully satisfied. Also, only 2 of the 10 QC Managers who worked on the project were licensed engineers.

Acceptance Testing Reassigned to QC

Originally Wasatch allocated a significant portion of their QC/QA staff to the QA group with a smaller staff assigned to QC. This was done with the expectation that the QA forces would perform acceptance testing. In April 1998 acceptance testing was assigned to the QC function, responsible for testing, inspection and contractor acceptance. At that time most of the staff assigned to QA who had been performing this type of function was reassigned to QC.

The QA role, staffed by Sverdrup/DeLeuw, was modified to be exclusively Quality Assurance monitoring to ensure that the quality of the QC tests remained in the acceptable range. The QA staff was reduced to approximately 10 people with a laboratory to support their testing functions. Two staff members were assigned to perform acceptance field tests and one person was assigned to operate the testing laboratory. Examining the quality of the construction was a secondary role. The Contractor viewed them as representatives of the designers.

Pavements QC Group

In the third year of construction Wasatch added a new segment of construction responsible for surface pavement construction. This was done because they felt that this work was unique and very production oriented and that having a separate segment for this activity would be more efficient. It also was done because the pavement process extended over all geographic segments and more consistency would be achieved by establishing this as a stand-alone segment. To support this new segment, Wasatch set up a separate QC team to monitor pavements.

Changes to Staffing Level

Initially there had been an overall manager of QA for the entire project and a QA Manager assigned to each segment. Each of the segment managers had one QA inspector, one technician and a document control person. Between 1999 and 2000, UDOT and Wasatch agreed to reduce the Wasatch QA staff to a single overall QA manager, a QA inspector for each segment, and one testing technician who covered all segments. This reduced the staffing level to about 10 people.

UDOT accepted this change because they had been performing some of the same QA tasks in their Independent Verification process. UDOT was satisfied that Wasatch was providing an equivalent level of performance with fewer personnel.

PARTNERING AS PART OF QC/QA

By joint agreement of UDOT and Wasatch, partnering was made a part of the project from its inception. A partnering process was established with escalation processes identified to handle and resolve issues. The emphasis of the partnering process was to enable resolution of issues and problems at the lowest level possible in the project organization and in a timely fashion.

The Wasatch and UDOT oversight teams held a partnering meeting once per month to discuss what was working well and where improvements were needed. These meetings were held at the project manager level and were used for coordination. Segment level meetings were held as needed when issues were raised requiring a decision. Very few issues were escalated above the segment level for resolution. One of the first issues that were escalated dealt with construction issues, differing site conditions, that arose at the north end of the project at the 600 North interchange. This resulted in the development of a Memorandum of Understanding (MOU) that was used extensively on the project.

Both UDOT and Wasatch Constructors firmly supported the concept of partnering and stated that they felt that the partnering process on this project was very helpful and worked well. Wasatch indicated they experienced strong support for partnering from UDOT's top management level and stated they felt that this commitment was critical to the success of the I-15 Project.

Memorandum of Understanding (MOU) and the Technical Agreement

Early in the project, a partnering session was held between Wasatch and UDOT to address the construction issues surrounding the 600 North interchange. UDOT had provided completed plans (sealed drawings) in the RFP for the construction of an interchange and railroad overpass at the 600 North interchange hoping this could expedite the start of construction. However, there were numerous problems associated with the construction of this interchange, such as potential claims for changed conditions, excessive settlement, changes made to the original designs, and other construction-related issues.

At the partnering session held to resolve the 600 North interchange issues, a Memorandum of Understanding (MOU) was created that became a partnering document. This agreement outlined the methods to be used to resolve construction issues associated with changes to the original design parameters. Specifically, it addressed the process required to modify the project without processing a change order or a claim.

The Technical Agreement process was established so that Wasatch could propose changes to the original contract documents or its own proposed execution plans. If UDOT agreed that the proposed changes were at least “equal to or better” than what was included in the original proposal, then the changes could be approved without processing a change order. Instead, a Technical Agreement was processed to document the change. All parties to the contract signed a partnering agreement that spelled out this process and agreed to accept it. This process subsequently was used extensively to handle changes to the original design-build proposal.

DATA COORDINATION & SECURITY

At the beginning of the project both UDOT and Wasatch used Primavera Expedition contract control software to track project information. The software was accessible through a computer network. UDOT staff recommended that a firewall be installed to provide security and protection for the program’s database. This was not done initially, making it possible for unauthorized access to occur and reported data changed. UDOT determined this was unacceptable, and a new, secure database was created for use by UDOT only. It required an extensive effort to set up the database and populate it with both old and new data, causing a period of inconvenience until it was up and running.

ACCEPTANCE TESTING

FHWA required that UDOT provide a means to accept the work and verify its quality. The Contractor also established processes to provide assurance to him that the work was being accomplished to an acceptable standard. Ordinarily, the Owner exclusively provides this function after his thorough inspection and testing of completed work. On the I-15 Project, many of these functions were assigned to Wasatch placing different responsibilities onto both Wasatch and UDOT. To define the functions of the respective parties, the following definitions were developed.

Contractor Acceptance Testing (CAT) was a test or inspection that determined the acceptability of permanent work as each construction stage progressed

Owner Assurance Testing (OAT) was testing conducted to determine if the CAT and QA tests that were being taken were representative of the work being tested. These tests were taken at a lower frequency than the CAT tests and were taken at random locations, not necessarily the same locations as the CAT tests. The independent testing firm, ATSER, performed OAT testing, under subcontract to UDOT. Their goal was to test approximately 10% of the tests made by Wasatch QC testers. ATSER prepared a statistical report that provided a means to measure or benchmark, to compare the CAT results. The reports from ATSER were available to the UDOT field personnel approximately one month after the tests were taken.

Independent Assurance Testing (IAT) was the testing conducted to verify the calibration of testing equipment and processes being used.

Independent Assurance (IA) was an unbiased and independent audit of the Quality Assurance OAT and Acceptance Systems used and was an independent verification of reliability of the test results obtained in the regular sampling and testing activities. The results of IA tests were not used as a basis of acceptance of material or work. UDOT Region 2 performed the Independent Assurance. They prepared a statistical report that compared the CAT, OAT and IA testing results. The report rated the quality of the test results in four categories:

1. Excellent
2. Good
3. Fair
4. Poor

Most of the results were placed in the “Excellent” category.

Conflict of Interest

Based on the information gathered in our interviews, this process should be looked at carefully in design-build-projects. A natural conflict occurs by having the Contractor performing the inspection and testing. The Contractor’s goal is to be on time and make a profit; it is, therefore, natural for the construction staff to look at an inspection as a potential hindrance to completing the work on schedule. However, balancing this is that the design-build Contractor is responsible for the QC process—scheduling the QC process and controlling the schedule.

CULTURAL CHALLENGES

UDOT felt that one of the biggest challenges to the QC and QA program was “breaking the mold” of the traditional roles of the Contractor and Owner. UDOT’s staff all came from the “catch and punish” culture. Wasatch personnel came from a similar background. To change philosophies to a more proactive role in quality by the Contractor and a less controlling oversight role of the Owner was a significant challenge. Most UDOT and Wasatch staff assigned to the I-15 Project had worked under traditional systems for many years and this was their first experience with this type of project.

UDOT staff believed they were only partially successful in overcoming this cultural change. It took more than a year to see a shift in the staff from either party. The project personnel became more comfortable with the new roles once they had positive experiences with them. However, there were individual cases where acceptance was never fully achieved.

Quality Control

To a large degree the QC role was fully shifted to Wasatch with broad acceptance of this by UDOT project personnel. This was especially true of the material testing functions of QC. UDOT relied extensively on statistical analysis of data to check performance of the testing role. The results of this analysis were consistently within the range expected, and the confidence level was high among project personnel. The level and degree of inspection by Wasatch staff was less well accepted by the UDOT’s staff. This was viewed as a result of the cultural change resulting from the Contractor responsibility for inspection by the Contractor represents. A shortage of available experienced inspectors from local labor pools contributed to this impression.

Quality Assurance

The changed QA role remained less completely accepted by either party. Wasatch indicated several times they would prefer to see UDOT retain this role. The stated feeling was that UDOT had traditionally provided this role, and it was difficult for Wasatch to assume this role. There was also an indication that

UDOT QA would have aided UDOT in accepting Wasatch's QC program and build confidence in that process.

Job Security

Job security of Owner staff also became an issue. There were some UDOT individuals who felt a threat to their job when the QC role was given to the Contractor to execute. UDOT had to reassure these employees that they would continue to have a job, even if it was changed from the historical practice. They also provided reassurance that not all projects would be executed using design-build processes and that traditional contracting methods would continue for many projects.

LESSONS LEARNED

Field Review Process

Wasatch instituted a field review process that basically sent all field design changes back to the designer of record for comment prior to implementing them in the field. It appears that it would have been more efficient if Wasatch had delegated this responsibility to a field level resident engineering position with each segment having a resident engineer on staff that could represent the designer in making field decisions. Many of the decisions could be made at the field level without having to go back through extensive design review. This would have expedited the process.

Laboratory Certification

Wasatch underestimated the time required to certify their materials testing laboratory for the project. It took approximately one year to obtain certification for their laboratory. UDOT provided certified laboratory services until Wasatch could obtain the certifications. On future projects, the Owner and Contractor should allow this much time for certification of the laboratories.

Quality Management Plans

The Contractor was required to prepare quality management plans for Design, Construction and Maintenance. These plans were required as part of the ISO-9000 certification process. The Design plan (DQMP) was prepared and approved in October 1997, approximately six months after notice to proceed.. The Construction plan (CQMP) was not fully approved until August 1998, more than one year after the project start. This was much longer than anticipated originally by UDOT but was required because of the relatively new processes developed in the plan and the need to get concurrences from both UDOT and FHWA prior to approving it. The Maintenance plan (MQMP) was never filed because the option for long-term maintenance was not taken by UDOT therefore the plan was not needed.

Personnel Certification

Wasatch had some difficulty in attracting certified inspection personnel to the project. This was due primarily to a shortage of qualified/certified personnel in the local market area and, to some degree, nationwide. In some cases, they had to conduct their own training to certify their inspectors.

Quality Assurance Role

UDOT field staff stressed that they would prefer to retain the Quality Assurance role. Wasatch also indicated that would be supportive of UDOT retaining this role.

Field Procedures Manual

UDOT had to develop their own manual of operation to maintain consistency in the oversight role. This was a new role for UDOT, and prior procedure manuals could not be used on the I-15 Project. UDOT experienced some difficulty in developing these manuals to reflect what was occurring in the field and which procedures they wanted to follow. It was almost two years after the start up of the project before UDOT actually had their operations manual in place. It would be preferable to have developed the manual earlier in the process, before construction began.

Magnitude of QC Program

Wasatch indicated that there were considerable budget overruns for the Quality Control program. They attributed most of the problems with the budget to underestimating the amount of testing and inspecting that would be required. This was further complicated by the staged construction that was used to expedite the project. In the future, the Contractor should evaluate the process that they intend to use to construct the project in more detail and take this into account as they establish budgets for providing QC services.

CHAPTER FOUR: INNOVATIVE CONSTRUCTION METHODS USED ON THE I-15 PROJECT

This chapter documents the innovative construction means and methods employed by Wasatch on the I-15 Project. While most of the methods were not necessarily new to transportation agencies in other states and jurisdictions, their use by UDOT was new. In some cases, the extensive use of these methods was unusual.

UDOT has conducted separate, detailed studies of some of these methods and will publish the results when they are completed. Those topics include use of wick drains, Geofoam, two-stage walls and mechanically stabilized embankment (MSE) walls. Some of these are long-term studies, and results will not be available until more time has passed and observations and measurements made. More information will be available from the UDOT Research Division of FHWA.

Settlement Issues

One of the challenging aspects of this project was addressing settlement of the soft underlying foundation soils under much of the highway. The Salt Lake Valley is a remnant of ancient Lake Bonneville. The foundation soils contain layers of very soft, compressible clay and silt with sand lenses of varying thickness interspersed. The farther north the location in the valley, the softer the foundation soils tend to be. Furthermore, the soils are highly compressible resulting in significant settlement when loaded with structures and fills.

When the original features of I-15 were constructed in the 1950s and 1960s, most foundations were surcharged for several years prior to constructing the final pavement and structures to allow the foundations to consolidate adequately. With a 4-1/2-year time limit for reconstruction of I-15 there was not enough time to construct the features in the manner normally used in the Salt Lake Valley. The required use of Portland Cement Concrete Pavement (PCCP) as the final roadway surface made excessive settlements unacceptable, after fills were placed. Furthermore, all bridge abutments were required to be placed on pile foundations, a typical Salt Lake Valley area requirement. Therefore, innovative ways to construct on soft foundations were considered by UDOT as necessary to complete the reconstruction.

Several options were included in the performance specifications developed by UDOT to account for the settlement amounts expected. It was projected that settlement on some of the highest fills could approach two meters. Options included:

- Lime cement columns
- Stone columns
- Wick drains to accelerate consolidation under load,
- Mechanically stabilized embankment (MSE) retaining walls
- Light weight fill
- Geofoam fills

Allowable secondary settlement, the settlement that occurs after pavement is placed, was limited by the design-build contract to less than 6 mm per lane width, transversely. If more settlement were to occur, under terms of the performance specifications and optional long-term maintenance agreements, Wasatch would be responsible to repair or replace it. Therefore, the objective of the design-build team was to construct fills so that all consolidation and settlement would occur during construction, prior to pavement

placement. This typically allowed a maximum of about 18 months for settlement and consolidation to occur prior to placing pavement or bridge decks.

Lime Cement Columns

Lime cement columns (LC columns) have seen only limited use in the United States, but have been used successfully in Scandinavia and Northern European countries for more than 25 years. They are primarily used for settlement reduction and bearing capacity improvement for soft, clayey soils and to improve the shear strength and stability of embankment foundations. Several patented processes are commercially available for this technique which requires specialized equipment to construct.

The LC column is constructed using a crawler-mounted machine that can be computer controlled. An LC column is constructed by injecting, under air pressure, a combination of dry (unslaked) quicklime and cement into soil, and mixing the soil, lime, and cement with a Kelly-bar-mounted tool as it is rotated and raised to the surface. This creates a column of treated soil that hydrates using water from the surrounding soils, with a resulting rapid increase in soil-column strength. The strength continues to increase for approximately one year at a diminishing rate.

In their original bid proposal, Wasatch listed LC columns as a potential technology for settlement reduction and soil stabilization. Some of the reasons cited by the Wasatch team for selection of LC columns in preference to other accepted methods of soil stabilization were:

1. LC columns were expected to be stiffer than stone columns and lead to reductions in settlement.
2. LC columns were expected to be more effective in reduction of secondary settlements.
3. LC columns were less permeable than stone columns, thereby reducing water flows through the soils where groundwater is encountered.
4. LC columns were anticipated to be quicker to install and less expensive than other technologies such as stone columns and deep soil mixing.

In spite of these advantages, this method proved to be too slow to meet the schedule requirements. It also had a high installation cost, and there were concerns about subcontractor production rates. Therefore, this method was only used in one location where Wasatch decided there was potential for damage to foundations of adjacent commercial buildings if wick drains were used.

Stone Columns

This process is similar to a lime cement column except the material removed from the borings is replaced with small stones to provide increased bearing capacity. Pea-sized gravel is typically used as the “stone.” Stone columns have proven effective in reducing hazards from the two primary sources of liquefaction-induced ground failure, 1-lateral spreading, and 2-loss of bearing capacity.

Wasatch chose a stone column system recommended by Hayward-Baker, Inc. It was preferred due to its estimated lower installation cost and higher production rate than other typical treatments such as deep piles, over-excavation and replacement filling, or soil mixing.

The stone column system consisted of an augured pier cavity into which graded aggregates are compacted in lifts approximately 300 mm thick. The aggregates are compacted using ramming equipment that imposes lateral pre-stress into the undisturbed soils surrounding the column. This increase in lateral or horizontal stress in the surrounding soils must first be overcome by strong ground motion induced stresses

before liquefaction will occur. Additionally, for liquefaction mitigation, free draining material can be used so that the stone column acts as a drain to relieve excess pore water pressures.

Wasatch used stone columns in isolated areas to mitigate liquefaction-induced settlement in case of a seismic event. The number of these areas was limited due to the cost of this treatment, and it was used only where alternative methods were not feasible. Stone columns were used in three locations near the Jordan River—one location in Segment 2 and two locations in Segment 3—and, reportedly, were easily installed.

Wick Drains

Wasatch used wick drains for much of the softer foundation areas. The wick drain process consisted of driving a corrugated plastic wick wrapped with a geotextile filter fabric into the ground. The wick drains provided a relief avenue for water compressed out of the soils as consolidation and settlement developed in the deeper soils. Properly placed, the drains can accelerate the rate of settlement and consolidation and reduce the time required to obtain the required settlement. These types of drains were used in areas where there was sufficient time to permit fills to settle before construction had to proceed. Many areas met these criteria, so wick drains were used extensively on the project. **Photos 1 and 2** show typical installations of wick drains.

Drains were typically advanced into the foundation soils by pushing or auguring them into place. Most of the drains on I-15 were placed by pushing them into the foundation soils up to 40-meters in depth using specialized equipment. The length and spacing of wick drains was carefully planned to achieve the desired settlement amount. Many drains were placed as close as one meter on center under embankments. A layer of free draining granular filter material was placed on the surface of the wick drains extending outside of the embankment area to provide continuous draining.

The use of wick drains was considered to be a great success on the project. Wasatch indicated that the drains produced the results expected and were relatively easy to install.

Embankment Fills

Wasatch proposed several methods of embankment construction. The schedule for construction required solutions to match the foundation treatments used to manage settlement. One option used was to replace granular borrow and fill with lighter weight materials to reduce the weight of the fills and resultant embankment and foundation settlement. Scoria (a naturally occurring expanded shale material) slag, and polystyrene foam (Geofoam) were all been employed to reduce the unit weight of the fill used.

Scoria and Expanded Shale. These processes involved substitution of granular fill material with either scoria or expanded shale with equal volumes of these lighter weight materials. No other special treatment was required to perform this substitution. Scoria and slag had been used in many other projects in Utah in the past..

Geofoam Walls. A local manufacturer developed a foam product called Geofoam to be used in a geotechnical application. The foam weighs approximately one-tenth as much as the equivalent depth of the granular fill it replaces, thus reducing the load-induced settlement. Extensive use of Geofoam has not occurred previously on a UDOT project because this procedure is relatively new to the highway construction industry.



Photo 1. Typical Installation of Wick Drains



Photo 2. Detail of top of Wick Drain

Wasatch used Geofoam in two types of applications.

1. ***Where settlement of the foundation areas would pose potential problems with existing utility lines not scheduled for relocation.*** At several locations, utility lines were located very near the proposed embankments or crossed under the embankment. In these areas Wasatch used Geofoam as a significant part of the fill to reduce the loads and associated settlement. The utilities that could have been most affected by excessive settlement were gravity pipelines, such as sanitary and stormwater sewer lines. There were other types of utilities where extensive settlement was expected to result in unacceptable conditions or expensive relocations. Most of this application of Geofoam was done in the downtown segment of the project where foundation soils are very soft.
2. ***Where the construction schedule did not permit sufficient time needed for embankment settlement before construction of pavement or structures.*** At several locations Wasatch had to complete work quickly to permit switchover of traffic to new lanes before the end of 1999. This was particularly necessary near the 600 South off ramps that needed to be completed in 1999 to maintain traffic into downtown Salt Lake City via the downtown interchanges. Therefore, there was not sufficient time for new embankment to settle and still implement the traffic management plan required to meet the construction schedule.

Photos 3 and 4 show a full section constructed of Geofoam. **Photo 3** shows concrete panels being placed on the outside face of a Geofoam wall. **Photo 4** shows construction of the concrete load - distribution slab on top of a geo-foam fill.

Geofoam Installation Procedure. Wasatch used large blocks of Geofoam to construct the embankments. The foam was an expanded polystyrene foam fabricated in solid blocks. The block dimensions were approximately 1.2 meters square by 6 meters long. The blocks were stacked much like hay bales using metal connectors to keep the blocks in place during construction. The metal connectors were placed at joints and spiked into the blocks on each side to hold the blocks firmly together. Once the blocks were placed, a geo-textile fabric material was placed on top of the blocks, encapsulating them. A reinforced concrete load distribution slab was then placed on top of the geo-textile fabric. This slab was reinforced with epoxy coated reinforcement steel and was generally 16 cm thick. After the concrete was placed at least one meter of granular fill material was used to completely encapsulate the foam blocks. After the fill was in place the standard section for pavement or abutments was used.

This load distribution slab was developed to meet design criteria considered by the design team. There was concern about protection of the foam, which is susceptible to damage by exposure to sunlight or through contact with petrochemical compounds that degrade the foam. The designers also wanted to distribute the imposed loads over more of the area of the foam blocks, and the concrete slab was intended to provide this distribution. **Figure 4-1** shows details of the construction method used. **Photo 5** shows a Geofoam wall, load distribution slab, granular fill and Jumbo slab used at an abutment of one of the structures located at 800 South and I-15.



Photo 3. Concrete Panels on outside of Geofoam wall



Photo 4. Distribution slab on top of Geofoam fill

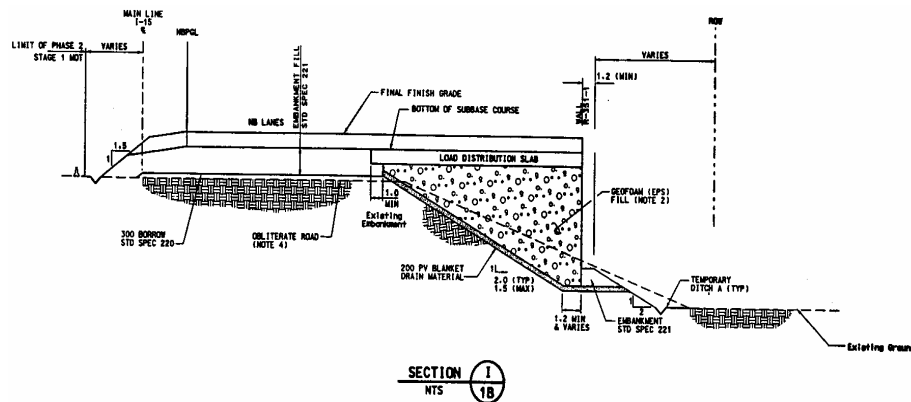


Figure 4-1. Geofoam Construction Method



Photo 5. Geofoam Wall Detail

Generally the performance of the Geofoam has been as expected by Wasatch and UDOT. Several fills 10 meters or more in height were constructed. The only unexpected observation was that settlement within the Geofoam block structure was greater than expected by either UDOT or Wasatch. Neither expected any significant settlement to occur within the block units, but measurements have indicated several millimeters of settlement at some locations. UDOT is conducting a more extensive study to evaluate Geofoam applications on the I-15 project. It is expected that results of these reports will not be available until the year 2004. The reader is referred to UDOT for status of these reports.

A significant event related to Geofoam occurred during construction. During construction of a segment near 500 North, which used Geofoam as a fill substitute, a crane came into contact with an overhead power line. The resultant fire was hot enough to destroy the crane and cause severe damage to the concrete pavement section on which the crane was parked. Wasatch removed the pavement and uncovered the Geofoam fill section to inspect for any damage to the Geofoam sections. No damage was apparent to the Geofoam blocks. The only damage visible was to the outside edge of the Geofoam section where the reinforcing steel used in the load-distribution slab had electrically grounded. The damage to the foam was not considered significant and the foam was not replaced as part of the repairs. Fuel that spilled from the crane also did not damage the foam. UDOT was pleased with the performance of the Geofoam fill in this situation.

Another issue encountered with Geofoam fill walls was the connection of the top of the facing panels to the load distribution slabs. The plans called for a steel pin cast into the load distribution slab to connect to the panels. Some of these sheared, disconnecting the top of the panels and in some cases causing the panel to tilt. Wasatch repaired this by installing new anchors, drilling from the outside, through the panel and into the load distribution slab. They also lengthened the anchors to increase the embedment length in the load distribution slab. This seemed to successfully address the problems.

All metal wire fabric, fittings and other attachments buried in the soil and used to tie the wall panels were galvanized to protect against corrosion. Further, the metal sections were heavier than needed to provide an allowance for section loss due to anticipated corrosion as an additional protective measure. Sample inserts of the wire were also placed in the embankment at various locations to permit removal and monitoring of the metal during the life of the structure. Small “doors” were left in the wall panels to provide access to the samples. UDOT intends to monitor the corrosion of the metal over time to determine its performance.



Photo 6: Two-Staged Wall

MSE Issues. Wasatch measured as much as two meters of settlement in some constructed walls. Deformation of the base of the wall was evident on some walls as settlement occurred. Wasatch prepared plans to correct for this situation. In the area near 500 North, on what is known as Argyle Court, settlement was observed in adjacent homes, requiring remedial actions by Wasatch, including jacking of foundations to realign them. This section was one of the first ones constructed. The problems encountered in this area resulted in changes to the procedures to construct the embankments, including changes to the compaction procedures and gradation of fill material used.

During the first year of construction several tall walls were erected using the two-staged method. After erection and before placing the facing panels, some of these walls experienced unexpected deformation along the welded wire wall face resulting in localized “bulging” areas. This tended to occur near the base of the walls but also occurred higher up in the wall along the face on others. This became an issue that was investigated thoroughly by Wasatch’s engineers, UDOT personnel, FHWA and special consultants. After completion of the investigation, it was determined that the walls were stable and that the two-staged wall system could be used even with the bulging.

Several changes were made to prevent or reduce the bulging on walls constructed after this problem was encountered. This included changing the type of embankment material used on the tall walls, the addition of closer spaced reinforcing straps near the base of the walls, and modifying the compaction procedures along the face of the walls. Wasatch made these modifications and walls erected subsequently experienced fewer bulging incidents.

The use of two-staged MSE walls was viewed as a critical element in the success of this project. The use of these types of structures enabled Wasatch to complete the work in the time frame required. Without their use the schedule probably could not have been met.

Post-Tensioned Concrete Decks

While not new to the industry, post-tensioned concrete decks on structures had not been used extensively by UDOT. On a large number of the steel girder bridges Wasatch increased the girder spacing to eliminate a girder line and reduce the number of required girders. To compensate for the wider girder spacing, the decks were post-tensioned transversely. Most of the steel girder structures used a post-tensioned concrete deck design, particularly where long or curved spans were required.

Deck Curing. A new method for deck curing has evolved within the industry over the past few years, but it was new to UDOT. This method uses burlin, a composite of burlap and plastic sheeting. UDOT had previously used only a wet cure method for bridge decks requiring sprinklers. With burlin, the deck concrete is fogged with a curing compound, the inside layer of the burlin is soaked with water, and no further water is applied. The plastic outer layer traps the moisture inside, on top of the concrete. This method was used successfully on this project. UDOT considered incorporating this method as an acceptable procedure in their standard specifications used on all projects.

Deck Cracking. On several bridges, primarily those constructed early in the project, deck cracking was observed after bridges opened to traffic. Micro-silica fume was used in the deck concrete, and in the first year decks were placed during summer daylight times when temperatures were high.

Wasatch sealed the cracks with merthacolate and installed a poly-carbon overlay on several decks where cracking was considered a problem. Wasatch also changed their placement process so that decks were placed during the night, with lower ambient temperatures. This resulted in fewer deck cracking problems on bridges constructed later in the project schedule.

Deck Grinding, Clearance Problems. Near the end of the project bridge decks were being ground to achieve the roughness coefficient and the smoothness criteria required in the project. On some decks the reinforcing steel was either exposed or concrete cover reduced below acceptable levels and remedial work was needed to replace the concrete cover. A Hilti ferroskan machine was used to scan suspect decks and determine concrete cover on reinforcement. This system worked very well and UDOT developed a high degree of confidence in the ferroskan system.

The tolerance for concrete cover in the contract was 50 mm (2 inches). UDOT permitted a minimum of 41 mm of cover as a construction tolerance. As a result of the review using the scanning machine, between 20 and 30 bridge decks were found to have insufficient reinforcement cover and had remedial work done. Wasatch placed poly-carbon and sand overlays over some of the areas to provide additional protection. Five decks had to be jack hammered and rebar lowered to provide sufficient clearance. This repair work was done on weekends when decks could be closed. In the future a larger minimum concrete cover should be considered where grinding of decks is anticipated.

Pre-Cast Concrete Spliced Girders (Nebraska Girders)

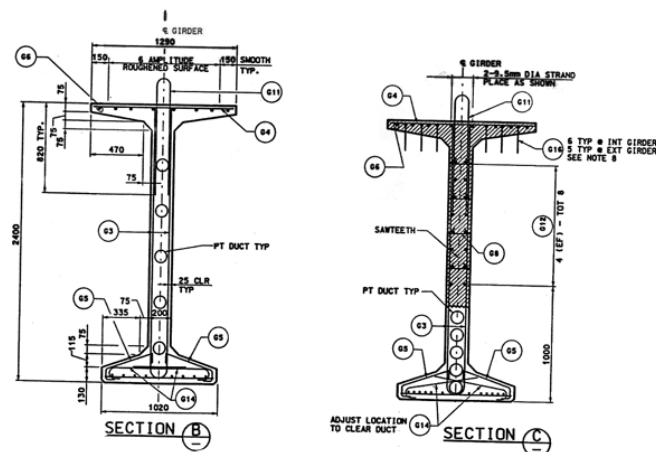
Wasatch used a pre-cast, pre-stressed concrete girder called a modified Nebraska Girder on structures where pre-cast concrete girders were used to achieve longer girder spans (approximately 100 meters in length)—primarily at the location of the single-point urban interchanges. They spliced and then post-tensioned up to three segments of pre-cast girders. Wasatch felt that this type of girder presented a significant cost savings over other types of girders.

The stated reasons for using this girder type were that they were:

- Lighter than an AASHTO type girder
- Capable of longer spans than AASHTO girders
- Familiar to Wasatch crews who had used them on other projects
- Permit wider girder spacing resulting in fewer girders in spans. The weight reduction is in the range of 500 kg per linear meter of girder.

In spliced girder applications, three girder sections were spliced together end to end to form the complete span. Girders were tied together and post-tensioned with the splices closed with cast in place concrete. Post tensioning tubes were cast into the beams when fabricated. **Figure 4-3** shows typical cross sections of the beams used. A local subcontractor set up a special operation to manufacture the girders for this project.

Some of the first group of girders supplied to the project had vertical cracks visible in the web section that raised concerns among the UDOT oversight personnel. A panel of experts was assembled to evaluate the potential problems and to develop procedures to limit future problems. Based upon the recommendations of the panel and concurrence by UDOT and FHWA, some of the girders were replaced and the manufacturing process modified to reduce the potential for cracking of the webs. One possible cause identified was with the method used to release pre-stressing cables may have resulted in cracking of the beams. This method was modified with satisfactory results.



Another problem observed by UDOT was the fragility of the girders. Because they were relatively deep girders with thin flanges and bulb corners, they tended to chip and crack when handled. UDOT had been more used to an AASHTO type girder which has a more robust cross section without thin edges. UDOT was concerned that many girders required patching and sometimes replacement because of the damage that occurred while handling and placing the girders. Once the girders were in place and decks cast, UDOT was pleased with their use.

Figure 4-3. Beam Cross Sections

Pre-Cast Deck Panels

The Wasatch designers specified pre-cast, stay-in-place concrete deck forms for most of the bridges. These are typically 100-mm (4-inch) thick pre-tensioned concrete slabs which could be produced off site and erected on either steel girders or pre-stressed concrete girders. They were used on all concrete girder bridges and some of the steel girder bridges. However, some panels were constructed without the pre-stressing.

These stay-in-place forms are used by several other states, the most notable being Texas. Wasatch management was enthused about them because they saved time and labor normally required in forming a deck soffit and removing the forms after the deck was placed. The pre-cast panels were set on the girders and became an integral part of the deck. Wasatch indicated that the potential labor savings was significant due to limited available workers who were experienced in concrete deck construction. An additional advantage was the reduction in the number of traffic closures normally required to remove shoring and forms.

Wasatch used pre-cast panels on all concrete girder structures. There were a large number of cracks in some of these panels, especially those fabricated in the earlier stages of the project. Two suppliers manufactured the panels and one experienced more problems fabricating the panels than the other. It is perceived that the subcontractor's handling and casting procedures caused the cracking problems. Most of these fabrication problems were remedied as Wasatch instituted its own quality control program with suppliers. On some of the panels UDOT made Wasatch drill in dowels to increase the shear resistance where the roughened surface finish was not considered to be adequate.

Moment Slabs

The designers developed a concept called moment slabs to be used above the two-staged MSE walls and Geofoam fills. The purpose of the slab is to cantilever the pavement over the top of the wall panels and not transfer load into them. Rather, the loads imposed by traffic and the roadside barriers are transferred into the moment slab. The moment slabs are thickened and reinforced to provide the moment carrying capacity.

Roadway barriers must be designed to withstand substantial horizontal impact loads. Since a two-staged MSE wall is not capable of withstanding a moment at its top induced by an impact on a barrier, the barrier was designed to attach to its own foundation. In this case, the barriers were placed on a reinforced concrete moment slab that varied from 2.4 to 5.2 meters in width. Slab thickness was typically 330 mm. The taller impact barriers used on this project could induce higher moments at their base than shorter ones typically used. The barrier reinforcing was designed to withstand the impact loads and the slab was reinforced to withstand them.

The width and thickness of the slab was designed to provide a dead load resistance to the overturning moment. Also aiding the overturning moment resistance was the weight of the impacting vehicle on the slab and the longitudinal load distribution. The typical applications where moment slabs were used are shown in **Figure 4-4**.

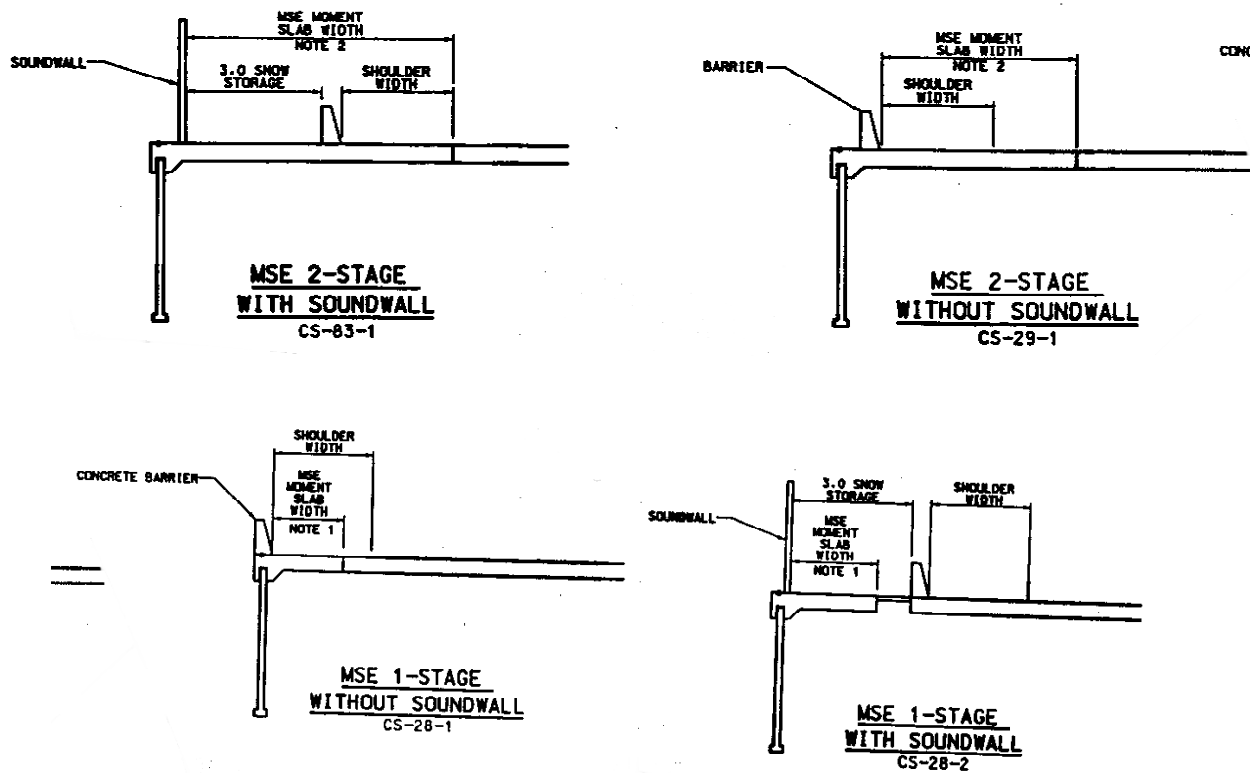


Figure 4-4. Moment Slab Typical Applications

The design as presented in the I-15 Project plans included drilled caissons placed at the roadway edge of the slab. The purpose of these caissons was to increase the uplift resistance and provide resistance to sliding. Both Wasatch and UDOT personnel indicated that no drilled caissons were actually installed in conjunction with moment slab construction. The dead load weight, soil friction, and distribution of point loads in slabs were considered sufficient to overcome the sliding and overturning forces without the piles. **Figure 4-5** shows details of how this was designed.

The I-15 Project used a rigid pavement design. With the possibility of substantial settlement, longer and thicker approach slabs were considered necessary. Longer slabs were also required to reduce the abruptness of the vertical angle change at the bridge.

Approach slabs have been designed in the past with a thickness of 254 to 305 mm. On this project four slab types were designed. Lengths of slabs vary from 8 meters to more than 16 meters. The shorter slabs were 375 mm thick and the longer slabs 580 mm thick. Because of the increased thickness of the slab, they have become known as “Jumbo” slabs. The four types not only provided two different thicknesses but also provided different joint treatments at the bridge. According to UDOT personnel, the thickest slab was only used in one location. **Figure 4-6** shows a typical design of the approach slab.

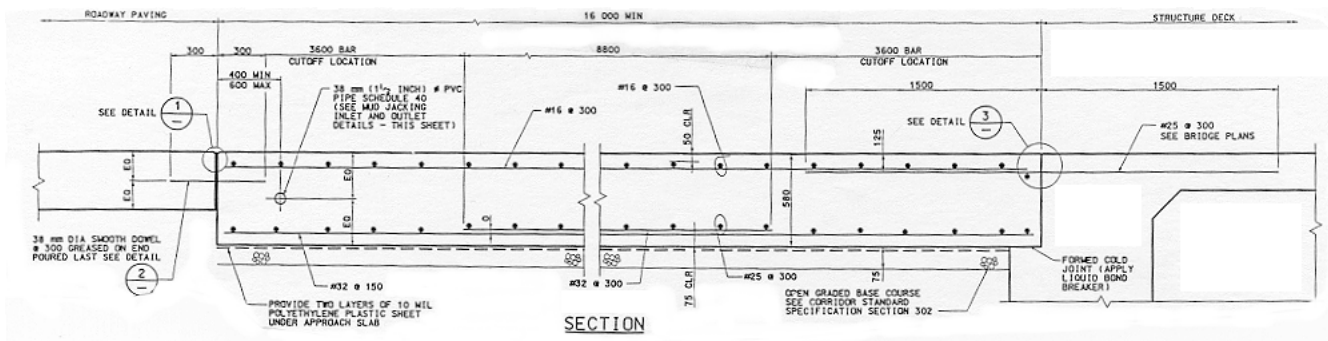


Figure 4-6. Approach Slab (Jumbo Slab)

Another innovative feature of the Jumbo slabs was the installation during construction of a system of 38 mm diameter pipes within the slab to provide for future jacking of the slab, in the event excessive settlement occurred. The intent was to provide the plumbing to permit injection of concrete or other substance to raise the outside end of the slabs. **Figure 4-7** shows typical details of this connection and piping.



Figure 4-7. Mud Jack Details

Seismic Design Criteria

Seismic design was a major concern during project planning because of the proximity to the Wasatch fault, located just east of the project. That fault lies at the western base of the Wasatch range and extends the entire length of the valley. Approximately 90 percent of the entire population of Utah lives within this region. While this fault has not been as active as those in California and Alaska, it poses a threat that could not be ignored.

UDOT initially hired Parsons, Brinkerhoff, Quade and Douglas (PBQ&D) to assist them in planning the project and developing the bidding documents. Included in that part of the work was the analysis of the seismic hazard that should be considered in the design. They were charged with developing seismic design criteria and construction details. PBQ&D subcontracted with Dames & Moore to conduct an extremely comprehensive seismic hazard analysis of the entire region. The ultimate goals of that study were the development of seismic design criteria and to present methods to evaluate the liquefaction potential of soils along the I-15 corridor. The seismic source models and liquefaction methods were developed in consultation with a Seismic Advisory Committee (SAC). The SAC had been assembled by UDOT early in the process. The SAC consisted of many experts in seismology and earthquake engineering, including Jim Gates and Ken Jackura from the Caltrans who had extensive recent experience in earthquake engineering as a result of several major earthquakes in that state. Also on that team were noted geotechnical engineers and seismologists from the local area, some from the three major universities in Utah.

Dames & Moore reviewed the geologic, tectonic and seismic data for the region, developed seismic source models, and selected ground-motion attenuation equations for the seismic hazard analysis. The advisory committee agreed on the design accelerations but there was some disagreement on the attenuation relationships procedure. Three response spectra were developed to match surface conditions and the geographical locations were identified in the documents. A guidance document was provided to all three proposers prior to the receipt of the formal proposals.

After Wasatch was selected for the I-15 Project, they were required to develop response spectra for the soft soils because the Dames & Moore spectra were not appropriate for other than the harder soils. (This is the similar problem that was faced in California after the Loma Prieta earthquake of 1989.) Wasatch Constructors used Woodward-Clyde to do this work. A Geotechnical Oversight Committee was established during the 30 percent design phase. Ultimately, a modified seismic design procedure was developed.

Wasatch adopted a bridge seismic design procedure that used a combination of AASHTO and ATC-32 procedures. That was considered appropriate because the ATC-32 document was developed by experts following the Loma Prieta earthquake and includes many advanced seismic design features. The ultimate design level earthquake used was a UDOT decision after advice from the SAC. They used a probabilistic approach but were convinced by Caltrans' Jim Gates to also compare this with a deterministic approach. A deterministic approach is less time consuming and much less costly than a probabilistic approach. It was felt that for most freeway-type structures the probabilistic approach was not justified. The designers used a 2500-year return period for the bridges and embankments and 50-year return period for retaining walls. The AASHTO specifications require a 10% probability of exceedance in 50 years. Wasatch and UDOT used a 10% probability of exceedance in 250 years. While this is much more conservative than the AASHTO requirement, it was judged to be more appropriate for Utah. For comparison the California seismic design procedures use a 1500-year return period.

Wasatch decided that all the bridges could be classified as “important bridges,” a designation used by AASHTO that requires a higher level of performance. Therefore, the performance criteria are higher than most states would use for typical freeway structures. Many of the bridge designers employed by Wasatch came from recent seismic design projects in California and they were instrumental in convincing UDOT and Wasatch management to utilize the ATC-32 recommendations for seismic design of bridges. They also utilized many details that had been used and tested on the west coast.

DESIGN LIFE AND PERFORMANCE CRITERIA

Pavement Performance Life

For the I-15 Project, UDOT used a performance specification which required a pavement design life of 40 years for all mainline pavements including, ramps, collector-distributor (C-D) roadways, auxiliary lanes, and intersecting roadways at interchanges. Specific concerns addressed in the specification resulted from the poor subsurface soil conditions existing throughout the corridor. Because of these poor soil conditions, concerns for frost susceptibility and entrapment of water within the roadway prism governed some of the decision-making process.

Two parameters that are important in any pavement design are the projected traffic loading and the underlying soil support. Based upon the values from these two parameters, a typical design-life for a rigid concrete pavement on I-15 is 30 years. UDOT increased this to a 40-year design life based upon a projected pavement loading of 90 million EASLs. UDOT also specified that the roadway shoulders were to have the same pavement structural section as the roadway pavement.

To address the concern for the expected poor underlying soil support, an open graded base course was specified with under-drain or edge-drain systems to remove moisture from the top 36 inches of base and sub base materials, increasing the soil support values and decreasing the frost potential. Although the open graded material was by nature difficult to compact, indications are that the placement was successful.

Other innovations were:

- Use of perpendicular random and staggered joints within the PCCP to mitigate the development of harmonic vibrations within vehicles traversing the surface
- Use of load transfer joints to spread vehicle loads over a larger percentage of surface area,
- Use of “engineered” bumps in the pavements prior to the approach slabs. The engineered bumps were an attempt to anticipate the settlement of an approach slab, so that once the slab settled the expected amount; the approach slab edge would align vertically with the adjacent pavement surface.
- Limiting joint spacing to 4.5 meters.

Long term ride quality was another innovation for this project. Normally ride quality is measured at time of acceptance and not at a future time. For this project measuring ride quality over time was desired and was established as criteria for the long term maintenance option. A maximum of 1000 mm/km (1/8 inch in 10 feet) deviation was specified over the first 4 years of surface life and 1400 mm/km (3/16 inch in 10 feet) after 9 years. These maximums are greater than the typical smoothness specifications used by most DOT's and UDOT (280 mm/km) prior to the I-15 Project. However, they were to be measured over a

long period of time. Traditional specifications are measured at time of acceptance only. The values set for the project were considered to be reasonable for the time periods between tests.

Structure Performance Life

A 75-year structure life was specified for all bridge structures designed for the I-15 Project. This specification was in addition to the seismic criteria discussed elsewhere within this report.

The innovations used were:

- Use of epoxy-coated conventional reinforcing (Pre-stressing steel was not coated)
- Minimizing the use of deck joints
- Disallowance of steel decking materials due to propensity for corrosion
- Use of deck coatings (stain) to seal against water and salt seepage through cracks in the concrete surfaces
- Bridges 110 m or less in length will have no joints and will use integral abutments
- Use of transverse post-tensioning on decks (new to Utah)
- Provision in specifications that required Wasatch to provide a 75-year life cycle cost analysis as a part of bridge design and analysis, including costs for scheduled maintenance and repair.

LESSONS LEARNED

Each of the innovative methods used on the project resulted in significant benefits to the project and have functioned as expected. Many of the problems associated with the use of these “innovative” methods were related to construction processes and procedures. Once they were refined, many of the problem areas were reduced or eliminated.

Longer-term results of these innovative methods will be available once more time has gone by and additional observations and measurements are made.

Settlement Issues

Wick drains have worked very well and within the expected ranges on the project. The use of lime-cement and stone columns was more limited than originally proposed. Stone columns were used, but only in limited areas along the Jordan River where they have performed well.

Lime Cement Columns

Lime cement columns proved to be too expensive and time consuming to be extensively used as a foundation stabilization method. They were used on a limited basis on this project even though the plan had been to use it more extensively.

Geofoam Embankments

The use of these fills was successful. UDOT’s long term monitoring program will yield valuable information for designers of future projects.

The connections of wall panels, especially at the load distribution slabs, need to be carefully considered to reduce potential problems. It was observed that Geofoam blocks exhibit settlement within the blocks themselves. This internal settlement was not expected. The method of encapsulating the Geofoam blocks

using concrete load distribution slabs and granular fill material apparently was adequate to provide protection of the foam from excessive heat and fuel spills.

MSE Walls

These walls have generally performed well. Bulging and misalignment of facing panels has occurred in some locations. Additional reinforcing and care in placement of backfill materials in the walls on tall applications reduced the bulging that occurred. Care must be given to the construction of the walls in areas where existing adjacent structures could be influenced by the wall settlement to reduce the impacts to these structures.

Settlement of embankments in the order of two meters or more requires special consideration for deformation of the face of the embankment. This resulted in some difficulty in attaching the second phase wall-facing panel to the face of the embankment and maintaining a uniform alignment. Extensive settlement of the embankment can result in settlement beyond the intended limits affecting adjacent properties. Modifications to compaction procedures and material gradation were made to reduce potential settlement outside of the intended areas on this project. These modifications have resulted in satisfactory performance.

Post-Tensioned Concrete Decks

The problems encountered with the cracking of these decks needs to be carefully examined. Generally these structures were quite flexible and this resulted in some of the crack formation. The procedures of placing decks during nighttime hours in cooler weather conditions appears to be have been beneficial.

Pre-Cast Concrete Spliced Girders

Establishing sound quality control procedures to be followed in the fabrication of girders is essential to successfully manufacturing them. This is especially important if the type and shape of the girders is substantially different than those normally fabricated by the supplier, as was the case on the I-15 Project. Care must be taken in handling girders with thin sections due to their fragility.

Pre-Cast, Stay-in-Place Deck Form

Good quality control methods must be implemented to assure uniform quality in the fabrication of panels, especially in the pre-stressing process. Care must be given to the methods used to release pre-stressing tendons to prevent cracking on the members. Use of Styrofoam blocks cut to fit the roughness of the girder tops was been useful in providing a more uniform support for the panels.

Spliced Girder Bridges

The use of these girders has been successful. There were construction problems associated with some of these girders but they appeared to be related to problems in alignment of ducts and shoring under the diaphragms during their construction.

Moment Slabs

The use of moment slabs appears to have been successful. However, some provisions for expansion and contraction of these long slabs should be made.

Seismic Criteria

Geotechnical engineering advice should be considered in the development of ground motion criteria to be used in the design.

CHAPTER FIVE: PERFORMANCE SPECIFICATIONS

UDOT had very little previous experience using performance specifications on projects. This chapter describes the types of specifications developed for the design-build RFP, how they were written for the RFP, and some examples of how these various types functioned when implemented on the project. Lessons learned are presented at the end of the chapter.

When UDOT made the decision to use design-build as the contracting vehicle for the I-15 Project, they decided to implement more performance oriented specifications as much as possible. Their justification was that performance specifications would:

- Provide flexibility to the Contractor to propose new methods and ideas for the design and construction of the project
- Provide flexibility to the Contractor to meet the time, cost, and quality constraints of the project.
- Assign appropriate responsibility and risk to the Contractor for design and construction means and methods.
- Allow the Contractor to optimize his resources for the project and better match with his capabilities, and let the designers design to the strengths of the Contractor.

A benefit to utilizing design-build was that it allowed the Contractor to be innovative and creative and to maximize the team's strengths. UDOT felt that by emphasizing this flexibility in the specification, the Contractor would have a greater sense of ownership, which in turn would lead to better quality.

UDOT prepared several performance specifications for use on this project. They also referenced their standard specifications, which are prescriptive, for several items not covered by the performance specifications.

TYPES OF SPECIFICATIONS

To understand the various types of specifications used in the construction industry and on the I-15 Project, a definition of specification established by the Transportation Research Board (TRB) was used.

TRB Specifications Categories

TRB published the *Glossary of Highway Quality Assurance Terms* in April 1996 that established definitions of various specification types. They are as follows:

- ***Material and Methods Specifications.*** Also called method specifications, recipe specifications or prescriptive specifications. These are specifications that direct the Contractor to use specified material in definite proportions and specific types of equipment and methods to place the material. (Each step is directed by a representative of the highway agency. Experience has shown this tends to obligate the agency to accept the completed work.)
- ***End Result Specifications.*** Specifications that require the Contractor to take the entire responsibility for supplying a product or an item of construction. The highway agency's responsibility is to either

accept or reject the final product or apply a price adjustment that compensates for the degree of compliance with the specifications.

- **Quality Assurance Specifications.** Also called QA/QC specifications. These are a combination of end result specifications and material and methods specifications. The Contractor is responsible for quality control and the highway agency is responsible for acceptance of the product.
- **Performance Specifications.** Specifications that describe how the finished product should perform over time. For highway projects, performance is typically described in terms of changes in physical condition of the surface and its response to load, or in terms of the cumulative traffic required bringing the pavement to a condition defined as “failure.” Specifications containing warranty/guarantee clauses are a form of performance specifications. Other than the warranty/guarantee type, performance specifications have not been used for major highway pavement components because there have not been appropriate non-destructive tests to measure long-term performance immediately after construction.
- **Performance-Based Specifications.** Specifications that describe the desired levels of fundamental engineering properties that are predictors of performance and appear in primary prediction relationships.
- **Performance-Related Specifications.** Specifications that describe the desired levels of key materials and construction quality characteristics that have been found to correlate with fundamental engineering properties that predict performance. These characteristics are amenable to acceptance testing at the time of construction.

DEVELOPMENT OF SPECIFICATIONS

Process

UDOT created a review team to manage and direct the development of the performance specifications for the RFP. The review team formed the parameters for the specifications, while smaller teams focused on writing the specific specifications sections.

UDOT personnel led the writing of the specifications by more than 100 UDOT and FHWA staff, UDOT consultants, industry and association experts, and academia specialists. The smaller teams prepared drafts of the specifications that were submitted to UDOT’s review team. Many of the team leaders remained on the UDOT I-15 Oversight management team through design and construction.

Risk

Prior to writing the specifications, UDOT had developed a matrix to identify the risks associated with the project, evaluate whether UDOT or the Contractor would be better suited to assume the risk, and identify what limitations should be placed in the specifications to achieve the desired results. The risk was assigned to the party they viewed as best prepared to handle it. This risk matrix was used as a guide to develop the parameters for the performance specifications.

Design Life

Because the I-15 facility is such a vital element of the transportation system in the Salt Lake City area, UDOT set goals for design life, or service life, of the major components of the project that were much longer than normally used in the transportation industry. For example, the structures and walls were designed for a 75-year design life while the pavement was designed for a 40-year service life. These design or service lives were criteria used to develop the performance specifications.

Changes Requested By the Proposer

UDOT released drafts of the specifications to the three short-listed design-build teams during the RFP process. The design-build teams were given opportunities to comment on the content. As comments were received, the specifications were revised, as needed, finalized, and released in the final RFP.

One significant change made based on the comments was the maintenance period required in the contract. Originally, UDOT had intended to require an extended warranty for performance of up to 20 years. Based on the design-build teams' comments made during the RFP development stage, UDOT concluded that this length of warranty was unrealistic and modified it to 10 years for specific elements. The final RFP stipulated the Contractor provide a cost to provide maintenance for the first five years and five subsequent 1-year periods, for a total of 10 years. This was an option that UDOT evaluated and eventually elected to not exercise.

Including QC/QA Roles in Specifications

The role Quality Control and Quality Assurance (QC/QA) would play in the performance specifications had not yet been finalized before the specifications were written. When UDOT finally decided to define the QC/QA activities as the design-build contractor's responsibility, it was very late in the development of the specifications. As a consequence, not much time was permitted to revise the specifications to address the planned QC/QA roles. UDOT staff indicated they could have used more time to consider the effects of this decision on preparing the specifications. They felt it was important to define the QC/QA role early in the development of the specifications so that they can be developed consistent with the goals of the project.

Task Force Meetings

The Task Force Meetings that occurred during the design process provided a forum where UDOT and Wasatch could clarify many of the procedures and methods not otherwise detailed in the performance specifications included in the original contract. Involving many of the authors of the performance specifications in these meetings also assisted in the interpretation of the specifications. Any design issues that could not be resolved in these meetings were resolved through the partnering process.

It was noted that the Wasatch management felt that the performance specifications worked well, but the UDOT oversight managers felt that they were not as enforceable as they would have preferred because some did not include sufficient specific enforceable performance criteria to go along with the specifications. Each UDOT segment manager expressed similar comments about this weakness.

I-15 Specifications Categories

On the I-15 Project, few of the specifications used were pure performance specifications—rather, they were referred to as “Hybrid” specifications. The term was chosen because even though the specification contained performance elements, they were combined with UDOT's Standard Specifications and was part of the design-build contract. After review of the specifications and how UDOT used them, the review team determined that many of the I-15 specifications fell into TRB's *material and method specifications* category, while others were *quality assurance specifications*. The “hybrid” generally fell into the *quality assurance* category, although some fell into the *performance-related specification* category.

The I-15 Project specifications were categorized into three broad categories, as follows:

Performance	Hybrid	Prescriptive
Landscape and Aesthetics	Roadway Geometrics	Pavement Design
Epoxy Paint	Drainage	Concrete Barrier
Geotechnical	Structures	Signing
Lighting	Water Quality	
Traffic Signals	Weigh-in-motion	
Maintenance of Traffic	Fiber Optic Utility Conduit	
Maintenance During Construction	Maintenance After Construction	

A discussion of some of the specific specifications and their use follows.

Performance Specifications

Maintenance of Traffic. UDOT's Operations Oversight Manager indicated that this specification was primarily a performance specification. This specification contained minimal requirements and restrictions and basically required Wasatch to follow the *Manual of Uniform Traffic Control Devices (MUTCD)* and conform to the *UDOT Standard Traffic Control Plans*. Although this specification did allow Wasatch maximum flexibility, some areas of the specifications created problems during construction.

UDOT's Project Traffic Engineer indicated that there was not enough specific information in the specification to limit nighttime closures or closures at times of significant community events, such as sporting events. The language in the specification required maintaining mainline traffic during peak hours and Wasatch interpreted that the freeway could be closed at all other times. Wasatch closed the interstate on many occasions (particularly at nighttime), which was not the original intent of UDOT. The ability of Wasatch to close complete sections of the freeway could have been more restrictive than was indicated in the specification.

It was also indicated by UDOT that the closing of on/off ramps to arterials was loosely described in the specification. An example of this was the requirement that an arterial road at an interchange only be closed for a maximum of six months. In actuality, some of these areas were effectively cut off for up to two years because of multiple phases that were constructed at the same interchange, even though each individual phase duration met the contract requirement. This did not meet UDOT's intent, but they were tied to the specific language of the contract. UDOT felt the intent of the specification could have been clearer, tying the ramp operations to the arterials so that the combined closure could have been limited.

Maintenance During Construction. It was believed that this was a true performance specification, which required the Contractor to perform routine maintenance (pothole repair, striping, edge drop off, etc.) on the existing facility. After award of the contract, UDOT recognized that the condition of the existing pavement and roadway was not as it had been represented in the RFP. The conditions had deteriorated to a point that Wasatch requested additional payment to continue to maintain the existing facilities during the construction period. The performance specification was not specific enough to enforce the level of maintenance UDOT wanted. Wasatch was also not able to keep up with the level of maintenance expected by UDOT. The estimated cost of this change order was approximately \$1 million. UDOT was faced with the choice of either paying Wasatch the additional amount or take the entire responsibility back to maintain the facilities. It was decided by UDOT to remove this portion of the contract and assume this responsibility using their existing Region 2 maintenance group. As a result of this decision,

Maintenance During Construction was removed from the contract with a change order resulting in a credit to UDOT.

Traffic Signals. This was a true performance specification that UDOT felt could have been more prescriptive in certain areas. One example cited was the method used to wire the sensors for traffic control loop detectors. It was indicated that the specification was silent on whether the Contractor could use parallel or series wiring configuration. UDOT has had difficulty with some of the sensors that Wasatch installed because the method used does not work well in Utah's environment.

Geotechnical. The flexibility in this specification allowed Wasatch to come up with innovative solutions for construction on soft foundations needed to meet the time schedule of the project. The consensus of those interviewed was that this flexibility was critical to the success of the completion of this project. Examples of these innovative methods included the use of wick drains, two-staged walls, Geofoam, lime cement columns, and stone columns.

The flexibility in the specification allowed Wasatch to come up with a two-staged mechanically stabilized earth (MSE) wall solution to address the settlement issues. However, because UDOT did not have an existing prescriptive specification to cover this type of wall, Wasatch prepared the specification with requirements that were in conflict with recommendations made by the FHWA in published reports. These FHWA reports were listed as references in the specifications, not requirements. This caused some concerns in interpreting whether they were required or not. It was recommended by UDOT that in future projects, these types of references be converted to requirements, which would then be binding on the Contractor.

Hybrid Specifications

Structures. This specification had a mixture of prescription and performance provisions. The specification was very prescriptive in areas UDOT wanted to tie down, such as materials, concrete cover, reinforcing steel, etc.; however, it allowed flexibility as far as the bridge type. The objective was to permit the use of structural types beyond those utilized in the past and to facilitate the proposed construction schedule. This flexibility allowed for the use of "spliced-girder" and transverse post-tension decks as options that would not have otherwise been used.

It was indicated by those interviewed that they would consider adding criteria for deck cracking on future projects. It was indicated that there was ambiguity in the performance specifications as to when and how to apply concrete cracking acceptance criteria and how to develop methods for repair. Methods of acceptance and repair were not specified and this has become a point of contention on how to interpret what is a suitable repair. If the agency has a preferred acceptance criteria and repair method, it should be specified.

Maintenance After Construction Specification. During the development of the design-build RFP and specifications, UDOT believed that requiring the Contractor to be responsible for the performance and maintenance of his designs and construction could enhance the incorporation of quality into the Contractor's design and construction. It was believed that true performance specifications work best when the design-build team is involved in the long-term maintenance and operation of the project.

Originally, UDOT had intended to require an extended performance warranty that extended up to 20 years. Drafts of the specifications were released for comments to the three short-listed contractors during

the RFP process. The three design-build contractors expressed concerns that this long-term obligation was not feasible for them to provide to UDOT at a reasonable cost.

After careful consideration, UDOT modified the contract requirements to include up to ten years of maintenance by the Contractor of specific elements of the construction. The final RFP required the Contractor to provide a cost option to provide maintenance for the first five years and options for five one-year periods up to a total of ten years of maintenance. The terms of the contract provided an opportunity for UDOT to invoke the first five-year maintenance period requirement near the end of the construction phase. In addition, the five one-year contracts could be added annually if the initial five-year contract had been chosen by UDOT.

The contract included provisions to adjust the bid amount over the life of the contract for the maintenance provisions based upon the *Federal-Aid-Highway Construction Urban (Composite) Index*. After the contract was awarded and construction nearly complete, UDOT became uncomfortable about adjusting Wasatch's lump sum price using the Index because it had become very volatile during the term of the contract. UDOT was not willing to assume the risk in the volatility of this index. UDOT recommended that a different index be used on future projects if one was included to address the time value of money issue. The contract also included provisions for sharing risk on cost overruns due to catastrophic problems not directly attributable to Wasatch or the quality of his construction. UDOT was not willing to take this risk either.

Wasatch's Maintenance Plan was contractually due on January 15, 2001. This plan detailed the maintenance effort that would be performed upon substantial completion of the project. UDOT was contractually obligated to exercise the Maintenance After Construction provisions by April 15, 2001. If UDOT had elected to accept the proposal for maintenance, Wasatch would have prepared a Maintenance Quality Management Plan (MQMP) and submitted it to UDOT. The purpose of the MQMP was to detail how and what quality programs the Contractor would use in implementing the Maintenance Plan.

Upon thorough review of the Maintenance After Construction specifications by both UDOT and Wasatch, it became evident that an effective Maintenance Plan would be difficult to develop. The requirements for maintenance were spread throughout the contract, which made it difficult to identify and monitor. The specifications also had some ambiguities, which made it difficult to interpret the requirements and assure UDOT would get what they intended.

In addition, UDOT was very comfortable with the quality of the completed project and felt that they could perform the required maintenance more efficiently and at a lower cost with their normal maintenance program. Therefore, UDOT decided to not invoke the Maintenance After Construction provisions. Because the provisions were not invoked, Wasatch was not required to submit the MQMP, so one was never prepared.

Prescriptive Specifications

Pavement Design. It was UDOT's original intent to make this specification as performance based as possible. As the specification was being developed, UDOT added several requirements to tighten up the specification, thus making it more prescriptive than performance. Following are a few condition items that were added:

- The Contractor shall design a Portland Cement Concrete Pavement (PCCP) section for mainline, ramps, collectors/distributors, auxiliary lanes and the east/west arterial pavement

under the new SPUI (single point urban interchange) interchanges for a minimum distance of 60 meters beyond the ramps or at the beginning of the left turn bays whichever is greater.

- The Contractor shall make adjustments to minimum layer thickness to accommodate climatic conditions such as frost depth. A minimum of 36 inches will be required to address frost.
- The Contractor shall design the PCCP joints with load transfer devices (i.e., dowels) to ensure minimum 80% load transfer at the joints.

The specification required a profile-o-graph test before acceptance and a profile-o-meter test at 4- and 9-year intervals after substantial completion had the Maintenance After Construction option had been exercised. It was recommended by UDOT that this be changed to require a profile-o-meter at year zero for comparison with the tests at 4 and 9 years. Profile-o-graphs cannot be easily conducted unless you close the facility to conduct the test.

Signing Specification. This specification was considered to be prescriptive. UDOT used much of their standard specification to prepare this specification, and most of it covers the fabrication and materials used in preparing the signs used on the project. However, the specification provided the latitude to Wasatch in the development of the signing plan, and the responsibility for the correctness and accuracy of the signing plans was placed directly with Wasatch rather than having detailed checks made by UDOT.

Some problems with the project's signing plans became evident after the facility was opened to traffic. The plans and specifications were not very explicit about signing requirements on routes leading to I-15. The reconstruction of I-15 resulted in many changes that affected drivers. This included reconfiguration of the three major freeway-to-freeway interchanges and many ramp reconfigurations at interchanges with local roads. Upon opening the facility, it was observed that drivers were experiencing confusion entering the project area. This was especially evident where the new facilities had changes in function or geometry from what existed before the construction such as the west bound I-80 entrance onto I-15. It became apparent that proper advanced signing outside of the project limits was needed to inform the users of the changes. Wasatch and UDOT developed additional signing plans for the areas outside of the project limits to improve the signing and provide advance notice to drivers.

UDOT recommended that on future projects the limits of the project be examined to ensure that sufficient construction limits are included to provide signing required to properly inform motorist of the new changes.

USE IN DESIGN

It was the consensus that although the specifications prepared for the I-15 Project were not true performance specifications, they did work well during the design stage. They gave the designer team latitude in the development of the design, yet there was enough prescriptive language in the documents to assure UDOT that the end product would be a facility that would meet their expectations.

The specifications worked well in allowing the design-build team to pursue innovative ideas to address challenging field conditions, while being able to maintain the very aggressive work schedule. Ideas proposed by Wasatch, and accepted by UDOT as meeting the performance specifications, were incorporated into the construction documents.

Geofoam

An example of this design latitude was the use of Geofoam in areas where subsurface conditions would have resulted in severe settlement or it would have taken more time to settle if normal embankment construction methods had been used. Wick drains were used extensively to accelerate the consolidation of subsurface materials and expedite the construction of new embankments.

Additional examples of innovative design ideas that were included in construction plans are the two-staged mechanically stabilized earth (MSE) retaining walls, lime cement columns, transverse post-tensioned deck slabs, and spliced girders. It is a direct result of the flexibility provided by UDOT in the specification that these ideas were used on the project.

Traffic Signals

There were times when the flexibility provided by the specifications did not provide positive results. For example, there was concern the Traffic Signals section of the specifications was too performance related. The team used designs that, while in conformance with the Performance Specifications, were not what UDOT had used in the past and now accepted as a standard. It was believed by the people interviewed that some specifications should have included more prescriptive language to assure the furnished and installed products were materials familiar to UDOT maintenance personnel. Where the design-build firm has the contractual ability to incorporate new materials/equipment into the design, it should be remembered that maintenance forces must be familiar with them or early maintenance may suffer until adequate maintenance procedures can be developed.

Structure Specifications

The majority of the UDOT structure engineers interviewed believed the structure specifications were satisfactory. Although the performance specification contained a number of prescriptive requirements, it was still performance orientated enough that it permitted Wasatch latitude to pursue innovative or alternative ideas.

Wasatch had a different perspective. Wasatch's position was that even though they had the opportunity to explore a number of different types of bridges, the prescriptive part of the specifications addressing such things as rebar types and sizes, concrete cover, etc., did limit the designers' ability to develop additional concepts.

It was pretty much agreed to by all the people interviewed that, with one or two exceptions, the developed specifications were probably more of a prescriptive specification than a performance one; (at least when the definition for these two types of specification is applied). The exceptions were the Lighting and Traffic Control Equipment, the Epoxy Paint, and the Landscape Aesthetics specifications. These specifications generally addressed only the end results and did not specify the means the Contractor was to use to obtain the result.

USE IN CONSTRUCTION

While the performance specifications allowed flexibility during design, once plans and specifications were completed and released for construction, Wasatch was very limited in what could change. There were also difficulties in the early stages of the construction when Wasatch wanted to make changes to the conditions and changes to the "sealed" plans that had been completed by UDOT and included in the RFP.

The original contract documents required these changes be made through change orders with price changes. Wasatch believed the performance specifications allowed the flexibility to modify the

documents to suit the Contractor's capabilities. UDOT interpreted the provision differently—believing it necessary to utilize the change order process for any contract documents.

This was such a critical issue that Wasatch and UDOT held a partnering session in January of 1998 where a Memorandum of Understanding was formulated and implemented.

Memorandum of Understanding and Technical Agreement

In January 1998, Wasatch and UDOT conducted a partnering session to address how to address this difference in opinion about the change process. As a consequence of that session, a Memorandum of Understanding (MOU) was developed and agreed to by both parties that provided more flexibility in considering design or construction changes. **Figure 6-3** shows a copy of this MOU.

This agreement simply stated that the Contractor was allowed to make changes to his proposal, performance specifications or standard specifications as long as UDOT agreed that the changes were “equal to or better” than the original contract requirements. Wasatch requested a change, and if UDOT concurred, a Technical Agreement was written to document the change. Once signed, it became part of the contract and modified the original contract, with no change to contract price or schedule. UDOT retained the authority to determine if the change was “equal to or better quality,” and Wasatch was free to present any information for UDOT's consideration of a proposed change.

Technical staff could proceed with reasonable changes, greatly reducing the processing time of proposed changes and providing UDOT with the comfort that the change would not affect the contract value or schedule. It also helped mitigate problems related to the inflexibility of some of the specifications, and gave Wasatch enough flexibility to meet the time constraints of the project.

There were more than 1,000 Technical Agreements processed during the design and construction of the project.

It was recommended that this concept or “equal or better” be considered for incorporation in other projects to encourage partnering and to allow appropriate changes to be made in a timely manner.

It was agreed by those interviewed that the construction plans released to the field for construction were prescriptive in nature. Wasatch generated prescriptive specifications (during the design) to be used by the construction personnel. This was required for the Contractor to direct his crews during construction and also to commit his subcontractors to specific elements of work.

LESSONS LEARNED

Performance Measurement Criteria. A pure performance specification requires that specific performance criteria and measurement standards be included. This is difficult in highway construction because in many cases the appropriate time to measure performance is several years after construction is completed. Examples of this are settlement of structures and fill and smoothness of pavement after several years of use. It demands that the specifications writer anticipate many years into the future to establish appropriate performance and measurement criteria.

Flexibility. Only permit flexibility where the Owner wants to permit the Contractor/Designer to have flexibility. If the Owner wants specific methods or products to be used, then prescriptive specifications are more appropriate.

Outcome Expectations. Where the Owner can define a method to achieve a specific outcome, a prescriptive specification is more appropriate than a performance specification. As an example, UDOT intended to have pavement be a performance specification, but upon review and development of the specification so many prescriptions were added that the specification became a prescriptive specification.

Measurement of Performance. The Owner should perform a thorough assessment of the project and the desired outcome before deciding what type of specification to use. If the measurement of performance cannot be adequately measured within the contract period, then a prescriptive specification is more appropriate.

Review of Specifications. Where an Owner has not had a track record using performance specifications, it is vital that a thorough review of the performance specifications be conducted to remove ambiguities and unenforceable requirements.

Maintenance Specifications. If maintenance is part of the contract, then the Owner should have staff with maintenance backgrounds on the development team preparing the specifications. The maintenance specifications for the I-15 Project were not as well defined as they could have been.

Flexibility in Use of New Methods/Materials. The performance specification did provide the opportunity for the design-build team to be innovative in some aspects of the design. Geofoam, wick drains, two-stage retaining walls, lime cement columns, and spliced girders are examples of methods of construction that were adopted.

Use of “Equal or Better.” The Memorandum of Understanding that permitted the Contactor to propose “equal or better” substitutions on methods, means and materials has proven to be critical to the success of this project. Similar provisions should be considered for inclusion in contract documents for future design-build projects.

Task Force. The use of design task forces composed of Owner and Contractor staff proved critical to interpret the intent of the specifications. On this project many of the authors of the specifications were included on the Task Forces, further enhancing the ability to interpret the specifications at the design stage where it was most effective.

Maintenance During Construction. Because the condition of the existing pavement and structures did not meet the expectations contained in the contract and the RFP intent, a change order was initiated to remove this from the contract and have UDOT assume responsibility. If the Owner wishes to place this kind of requirement on a Contractor, the Owner must be prepared to evaluate the condition at the time of award to verify that the condition is consistent with the intent of the specifications.

Experience with Performance Specifications. As more experience is gained in the transportation industry with performance specifications, it is expected that more specifications will be developed and proven in practice. This additional experience will be invaluable in improving the quality of the specifications and their application to the transportation industry. UDOT was one of the first to attempt to use performance specifications on this type of project and the lessons learned will be valuable to the industry.

Patterning Specifications after Existing Ones. If using existing specifications as a starting point, care should be exercised to make sure the new specifications include all of the important elements. During the

process of modifying the UDOT standard specifications and making them more performance oriented, sections of the specifications that were viewed as being too prescriptive were removed. This led to unintentionally removing sections that were not covered anywhere else in the specification.

An example was the use of grounding rods at the control cabinets in the traffic signal. The only place that the grounding rods were referenced was in the measurement portion of the standard specification. This portion was removed and, therefore, it became difficult to enforce the requirement of grounding rods because the specification did not include them.

Maintenance After Construction. The Owner needs to take care in establishing the requirements of the specifications so that the outcome intended is fulfilled. The feasibility of requiring long-term warranties or guarantees needs to be thoroughly evaluated if the Owner intends to use them. The use of cost indices to adjust for escalations in cost during long-term periods needs to be carefully evaluated to use indices that are appropriate for the use and are not excessively volatile.

Of all the specifications reviewed it is believed the Maintenance after Construction specifications were the most ambiguous in their intent. This was especially true when considering they would be governing the maintenance operations for ten years after completion of the work.

Partnering. When using performance specifications, especially on a design-build project, it is highly recommended that a partnering process be included as part of the project contract. This becomes especially important in interpreting the intent and meaning of the requirements.

Limits of Project. On similar projects where major road configurations are changing, consideration must be given to directional signing that will be required to reacquaint users to the new configurations. This may require that signs be placed outside of the normal limits of a project.

Field Design Changes. A process for tracking field design changes is important on any construction project. It becomes more important on a design-build project where performance specifications have been used to enable the Owner to track changes that may have resulted to ensure that they continue to meet the intent of the contract.

CHAPTER SIX: PARTNERING PROCESS

The I-15 Project used a partnering process extensively. This chapter discusses some of the unique features of that process. It also presents some of the anecdotal examples of successes and limitations of the process. UDOT and Wasatch each attributed the success of the project to the partnering commitment made on the project by each party.

PARTNERING DEFINITION

Partnering is a formal process of setting common goals, determining objectives, and resolving disputes in order to build a high level of trust between the many stakeholders engaged in the performance of a construction project. Its stated advantage to each party lies in its ability to accelerate the decision making process, speedily resolve conflicts, and eliminate or dramatically reduce the need for litigation between parties at the end of the project.

COMMITMENT PRIOR TO RFP RELEASE

In 1991, Mr. Tom Warne, was the State Construction Engineer when partnering was first implemented with the Arizona Department of Transportation (ADOT). He was tasked by his executive director to educate the department's employees on the advantages of partnering and to advance its use. Later, after becoming the executive director of UDOT Mr. Warne continued to advocate the use of the partnering process, encouraging its use within UDOT.

When the I-15 Project began, Mr. Warne strongly recommended the use of facilitated partnering. He held discussions with each proposer prior to soliciting Requests for Proposals (RFPs), sharing with each of them his vision of the project and the need for partnering. He also shared this vision and the need for partnering with his UDOT managers and staff, encouraging those chosen for the I-15 Project to implement the partnering process. Each of the contractors indicated that they wished to use partnering on this project.

The successful contractor, Wasatch, elected to use partnering on the project and enthusiastically supported this concept. To assist in developing the image of a partnership and reduce barriers and foster a spirit of unity, everyone involved in the project, both Owner and Contractor, was branded as part of the "I-15 Team."

PARTNERING ORGANIZATION

A Project Board of Directors (BOD) was established once Wasatch was chosen and the contract signed. The BOD was composed of the top-level management of UDOT and Wasatch, which included the principal partners of Kiewitt, Granite and Washington Construction. UDOT's executive director, Tom Warne was chairman and Al Kirkwood, Vice President of Kiewitt was the sponsor (see the following chart).

Project Board of Directors

UDOT

Tom Warne (Chairman)
Clint Topham (Later John Njord)
David Downs (Later John Bourne)
John Bourne (Later Dal Hawks)

FHWA

Mike Ritchie (Later David Gibbs)

FACILITATOR

Chuck Cowen

WASATCH CONSTRUCTORS

Kiewit Construction

Al Kirkwood (Sponsor)
Conway Narby (later Bill Murphy)
Larry Cochran

Granite Construction

Dick Lewis
Gary Higden
Washington Construction
Tony Ferruccio

The BOD met every two months throughout the project to discuss issues, review the schedule, and tour the project. As an aid in building and sustaining a relationship, they always shared meals together, splitting the cost of the meetings between UDOT and Wasatch.

Facilitator

Wasatch was asked to choose the facilitator to facilitate all of their meetings and run the partnering program. Chuck Cowen, a former ADOT director, was chosen. UDOT and Wasatch equally split the cost of his services.

Based on expense and logistics, it soon became apparent that Chuck Cowan would not be able to conduct all the planned partnering sessions, so he was retained on a part-time basis. Pat Crooks was hired by the BOD to be the full-time project facilitator. In order to reduce the appearance of bias, her salary was paid half by UDOT and half by Wasatch.

First Partnering Session

Chuck Cowen facilitated the first partnering meeting with the BOD, the three UDOT project segment managers, the UDOT team managers of ATMS (Automated Traffic Management System), Contract Administration, Pavements, Public Information and Design, and the Wasatch's counterparts to UDOT. The product of this meeting was the I-15 Reconstruction Partnering Charter, which was signed by all team members on May 6, 1997. The one-page overall project charter contained the common goals of safety, quality, schedule, budget, performance and teamwork. All partners signed and agreed to support the charter. **Figure 6-1** is the charter.

UPRR Partnering Session

Due to the many critical issues concerning railroad crossings, a partnering session was held with the Union Pacific Railroad (UPRR), with the cost being split between UDOT and the UPRR. The session initially helped the project in addressing the potential conflicts at the 120 crossings along the corridor. This partnering effort was very successful at the start of the project. However, the partnering process with UPRR was not emphasized during the rest of the project. UDOT managers felt that it would have been useful to continue the partnering efforts with the UPRR throughout the project because there were times, later on, when the process would have been helpful.

**UDOT / Wasatch Constructors, J.V.
I-15 Reconstruction Project
Partnering Charter**

May 6, 1997

We the partners commit individually and as a design/build team to the successful reconstruction of I-15. We will achieve this through mutual trust and by communicating openly, honestly and respectfully in the best interest of the Project. We will work proactively to prevent issues from impacting our project. As one team, we will remain focused on our common goals.

SAFETY
Safety first and always
An accident free work place
Provide safe passage for the public

QUALITY
Meet or exceed the agreed upon requirements
Do it right the first time
Effective Contractor QO/QA

SCHEDULE
Target completion July 15, 2001
Meet or beat intermediate milestones throughout the Project

BUDGET
Achieve all Partners' financial goals
No unresolved issues at the end

PERFORMANCE
Achieve 100% of the Award Fee for:
Quality - Time - Management - Community Relations - Traffic Management

TEAMWORK
Effective working relationships
Live up to our commitments
Fulfill each other's expectations
Enjoy the job

By accomplishing these goals we will establish a model and standard for future projects, justify the confidence that community leaders and the public have entrusted with us, build enduring friendships, professionally develop our people, and take pride in a job well done.

Figure 6-1. I-15 Reconstruction Project Partnering Charter

PARTNERING PROCESS

Charters at Each Level

Below the executive and sponsor level, each of the four operating levels of the project's management formed partnering teams and held a facilitated partnering session. At the first session, a charter for each team was developed, based on the overall charter of the project. Afterwards, monthly meetings of each level's team were held to resolve conflicts and problems. However, either party could call a special partnering meeting at any time if the need arose. **Figure 6-2** is an example of a segment level charter. Each segment developed its own charter.

Escalation Ladder

To aid in the resolution of disputes, an escalation ladder was established for each work segment and team. If a dispute arose that could not be resolved at that level, it was elevated to the next level of management. The hierarchy for dispute resolution ran from the task force or field level, where most issues were resolved, to the second level, the design manager level. The third level up was the deputy project director level, then the project director level, then to the UDOT executive director and contractor sponsor level, and, finally, if necessary, to the top of the escalation ladder, the Dispute Resolution Board (DRB). Along with the escalation ladder, a timetable was developed for how long a dispute was allowed to remain unresolved before it was automatically elevated to the next level of authority for resolution.

The DRB had three members. One member was chosen by UDOT (Burke Peterson), another by Wasatch (Bill Peckham), and the last, a neutral and unbiased person (Ben Dibble), was mutually chosen by the other two members. The DRB met quarterly for the duration of the project and was brought up to date on the project's progress at each meeting. From the beginning, Tom Warne of UDOT and Al Kirkwood of Kiewit agreed to not involve lawyers in resolving disputes and gave the DRB final say in all matters. During the project the DRB had only one issue brought to it for resolution. This issue concerned OCIP (Owner Controlled Insurance Program)—coverage of an off-site trucking company delivering materials to the site. While DRB decisions were not necessarily binding it was agreed by both parties that in this case the decision would be binding to both parties.

Facilitator Role

For each partnering meeting below the BOD level, the full time facilitator, Pat Crooks, kept track of the issues lists from the monthly evaluation forms, scheduled the meeting, developed an agenda with the aid of the team members, facilitated the meeting, and took notes. After the meeting she would write up the minutes, develop a list of action items for the next meeting, and distribute the minutes and action items to each team member. The action item list was especially useful for it encouraged people to make comments during the meetings and take action after the meetings.

Every person interviewed cited that the full-time facilitator was essential to the success of the partnering process and thus the successful completion of the project ahead of time and under budget. Also, the formal, facilitated partnering process encouraged communication and feedback and provided an open forum to work out problems and handle concerns. The full-time facilitator also ensured that the process continued and that someone championed the process for the duration of the project. This became more important the longer the project lasted. Without this constant emphasis, it would have been easier to skip some or all of the process.

UDOT/Wasatch Constructors, J.V.
I-15 Reconstruction Project – Downtown Segment
Partnering Charter

Revised March 1, 2000

We the partners commit individually and as a design / build team to the successful reconstruction of the I-15 Downtown Segment. We will achieve this through mutual trust and by communicating openly, honestly, and respectfully in the best interest of the Project. We will work proactively to prevent issues from impacting our project. As one team, we will remain focused on our common goals.

SAFETY

Safety first and always
Zero tolerance for unsafe acts and unsafe conditions
Everyone is responsible; never walk past an unsafe act or condition
Respect our adjacent neighbors
Focus on protecting the traveling public
Respect the environment

QUALITY

Each person takes responsibility for their work
Achieve quality as a team by seeking continuous improvement
Do it right the first time
Respect and confidence in the QC group
Take personal pride in our work

SCHEDULE

Beat target completion of July 15, 2001
Mainline open to traffic by May 15, 2001

BUDGET

Coordinate resources for the benefit of the project
Understand that all parties have a cost
Do not do anything to create unnecessary cost

PERFORMANCE

Achieve 100% of the Award Fee

TEAMWORK

Communicate, understand and strive to fulfill each others expectations
Resolve issues in a fair and timely manner
Remain focused on the long term goals

By accomplishing these goals we will establish a model and standard for future projects, justify the confidence that the community leaders and the public have entrusted with us, build enduring friendships, professionally develop our people, and take pride in a job well done.

Figure 6-2. Segment-Level Charter

Regular Evaluations

During the first partnering sessions at each management level below the BOD, partnering evaluation forms were created and filled out on a monthly basis. Essentially these forms were developed from the list of goals found in the partnering charter for a particular management level. The forms covered categories such as communication, cooperation, and the response to issues that were raised, safety, quality, schedule, budget, performance, teamwork, and the escalation process. Sample memos and forms are shown on the following pages. The first example was used by the design phase team; the second example was used by the construction phase team of the project.

Using these forms all team members rated the various categories monthly, on a scale from one to five, with five being the highest score. Comments justifying the scores were required for all scores less than 4. Thus, a score of 3 or less was used whenever an issue of concern arose that needed addressing by the group's leadership. Although not mandatory, comments were encouraged for scores of 4 or 5 as well.

The evaluations could be confidential, although it was recommended that they not be, so that direct communication could take place between the individuals concerned in an issue. However, anonymity allowed people the chance to more openly express themselves on touchy issues. Each month Pat Crooks collected the completed evaluation forms, reviewed the evaluation data, and entered it into the database. The data and comments were effective tools that identified problem areas that could then be addressed in the next partnering meeting. The comments were considered of greater value to the team members than the actual scoring. However, for upper management both the number scores and the comments were considered to be important. The number scores provided a method for getting a quick overview of the overall health of the project and the comments provided background into the specifics of issues where upper management could use intervention to assist in their resolution.

An example of a scored evaluation is shown on pages 6-15 to 6-18.

Evaluation Meetings Frequency

In the beginning, partnering evaluation meetings were held monthly. However, it rapidly became apparent that with all of the other meetings people were required to attend, they were having too many meetings. Thus, the frequency of the partnering meetings was adjusted to every other month. By the end of the project it had been reduced to quarterly. These meetings were held even if all the ratings were 4 or greater, signifying agreement. The purpose was to provide a forum for issues that had either not made it into the evaluation forms or were concerns for future issues that could possibly be problems. Also, towards the end of the project the number scores were dropped from the scoring forms, but the comments were continued and encouraged.

Nurturing Relationships

Since a primary objective of the partnering was to create teams, it was essential to eliminate the "them versus us" mindset and to build trust. Thus, the relationships started in the partnering process were nurtured along the way. This nurturing took many forms, such as sharing lunches and dinners, celebrating project milestones, sharing in holiday festivities and activities, and participating in sports or sports activities together and other social events that built an atmosphere of camaraderie and trust. When troubles arose, the managers would make a conscious effort to get the team together for something social.

Reaffirmation

After two years, at approximately mid-project, a reaffirmation-partnering meeting was held with all the partnering groups with about 70 people. The charter was reviewed and refined and once again signed by all the operating level team members.

MEMORANDUM

TO:	<u>Wasatch</u>	<u>I-15 Team</u>	<u>Sverdrup/DeLeuw</u>
	Andy Hoff	Dan Church	Gary Adams
	Tracy Martin	Don Clark	Jim Dodson
	Bill Martin	Ray Cook	Jim Klemz
	Tom Howell	Craig Frisbee	Dave Korpi/P. Bott
	Jerry Porter	K.N. Gunalan	Gary Robinson
	Pat Soderberg	Gene Kammerman	Steve Shive
	Bruce Wilson	John Leonard	Tony Stirbys
	John Wise	Pete Marshall	Jiri Vitek
	Marwan Farah	Del Miller	
		Dave Nazare	
		Mike Robertson	
		Si Sakhai	
		Matt Sibul	
		Mike Arambula	

FROM: Pat Crooks, Partnering Coordinator

DATE: October 12, 1998

RE: **MONTHLY PARTNERING EVALUATIONS - Design Group**

Attached is the October Partnering Evaluation for the Design Group. We need your participation to measure how well the Team is doing. Everyone's input is valuable!

When responding, please read the full goal statement and comment on your scope within the Design Group. Do not rate on what is happening outside of Design.

There have been several questions raised on how to use the 1-5 scale when rating. A score of 4 would mean that everything is okay - there are no specific issues or concerns you want to raise or comment on, and there is still room for improvement. A score of 3 or less would be appropriate when you have issues or concerns that you want to have addressed by the group's leadership; a score of 3 or less needs to be accompanied by a comment. We also appreciate comments on ratings of 4-5 so we can understand your rating.

<p>Please complete your evaluation and return it no later than Friday, October 16, 1998. The 2nd, 13th and 21st person to turn their evaluation in will receive a gift - will it be you???? Last months winners were Jerry Porter and Bruce Wilson. The 3rd prize was not awarded because we only received 22 responses.</p>

Fax or mail to the attention of:
Pat Crooks
Wasatch Constructors
Fax # (801) 594-6813

Guidelines For Preparation and Review of Monthly Partnering Evaluations

The purpose of the monthly partnering evaluation is to provide a means for all levels of managers on the project to communicate their thoughts, concerns and insights to senior management on a routine basis. Everyone's concerns and opinions are important and need to be heard and acted upon as appropriate.

When completing the evaluation form the response is from commenting on "budget" would probably respond in the context of the subcontractors budget; however, if he has insight on impacts to the point of view of the person evaluating. For instance, a subcontractor the overall project budget, those comments would also be appropriate. The focus and comments can be as broad or narrow as the individual desires.

Written comments are particularly important as they provide senior management more insight as to the specifics of the issue. This is why we ask for comments on ratings of 3 or less. The expectation is Project Managers and Sponsors will look into the issues to assist in their resolution.

Evaluations can be confidential although we recommend they not be so that direct communication can take place with the individual concerned.

Keep in mind that the evaluation is tied to the Charter we developed at the very beginning (first workshop). As honorable people, we committed to act in accordance with the Charter guidelines and work in concert to achieve the charter goals.

**UDOT/ Wasatch Constructors
Design Group
September Partnering Evaluation**
(Base responses on your experiences since the last evaluation)
FAX to (801) 594-6813

Name: _____ Date: _____

Company: _____ Tele: _____

Representing: Owner___ Designer___ Contractor___

Evaluation Policy:

Fax directly to Pat Crooks, Partnering Coordinator, or mail in a sealed internal mail envelope.
Name and telephone number are for follow-up purposes only. Confidentiality will be maintained if you do not give your permission to divulge your name. [] **Please check here if you do not want your name divulged to project managers for follow-up purposes.**

NOTE: Comments are required on evaluations rated 3 or less and appreciated on ratings of 4-5 so we can understand your rating.

1. Communication between the Owner, Designer, and Contractor is:

Poor 1 2 3 4 5 Excellent

2. Cooperation between Owner, Designer, and Contractor is:

Poor 1 2 3 4 5 Excellent

3. When issues are raised, the response is:

Slow 1 2 3 4 5 Timely

We are successfully meeting our project goals:

4. SAFETY. Meet RFP design requirements as supplemented by design criteria requirements for both temporary and permanent construction.

Not at all 1 2 3 4 5 Absolutely

NAME: _____

(Design Group)

5. QUALITY. Meet or exceed the design requirements of the RFP and proposal. Obtain design approval for each final package with first submittal. Minimize the need for field design changes. Implement design program that complies with ISO 9001 certification.

Not at all 1 2 3 4 5 Absolutely

6. SCHEDULE. Target design completion November 30, 1998. Deliver “release for construction” package to meet construction milestones.

Not at all 1 2 3 4 5 Absolutely

7. BUDGET. Complete design at below the target price. Beat target quantities by 5%.

Not at all 1 2 3 4 5 Absolutely

8. PERFORMANCE. Achieve 100% of award fee for design elements. Quality - Management

Not at all 1 2 3 4 5 Absolutely

9. TEAMWORK. Have a professionally rewarding experience. Develop a work environment based on respect trust and cooperation. Maximize Owner/Designer/Constructor collaboration for design solutions. Fair and timely issue resolution. Work together to meet construction segment expectations.

Not at all 1 2 3 4 5 Absolutely

10. Are you using the process to escalate unresolved issues to the next level in a timely manner?

Not at all 1 2 3 4 5 Absolutely

MEMORANDUM

TO: **Wasatch**
 Tracy Martin
 Bill Martin
 Tom Howell
 Jerry Porter
 Pat Soderberg
 Bruce Wilson
 Jim Jewell
 Ryan King
 Kristin Hemenway

I-15 Team
 Dan Church
 Ray Cook
 K.N. Gunalan
 Pete Marshall
 Del Miller
 Dave Nazare
 Scott Palmer
 Si Sakhai
 Matt Carter
 Will Reeves

Sverdrup/DeLeuw
 Doug Lattin
 John Terry
 Steve Shive
 Cheryl Hersh
 Steve Hankins
 Michael Bloomquist
 Von Larson
 Al Needham
 Bill Turner

FROM: Pat Crooks, Partnering Coordinator

DATE: March 9, 1999

RE: **MONTHLY PARTNERING EVALUATIONS - Post Design Services Group**

Attached is the March Partnering Evaluation for the Post Design Services Group. We need your participation to measure how well the Team is doing. Everyone's input is valuable!

When responding, please read the full goal statement and comment on your scope within the Design Group. Do not rate on what is happening outside of Design.

There have been several questions raised on how to use the 1-5 scale when rating. A score of 4 would mean that everything is okay - there are no specific issues or concerns you want to raise or comment on, and there is still room for improvement. A score of 3 or less would be appropriate when you have issues or concerns that you want to have addressed by the group's leadership; a score of 3 or less needs to be accompanied by a comment. We also appreciate comments on ratings of 4-5 so we can understand your rating.

<p>Please complete your evaluation and <u>return it no later than Friday, March 12, 1999.</u> The 5th, 11th, and 17th person to turn their evaluation in will receive a gift - will it be you???? Last months winners were Jerry Porter and Guna.</p>

Fax or mail to the attention of:
Pat Crooks
Wasatch Constructors
Fax # (801) 594-6813

Guidelines For Preparation and Review of Monthly Partnering Evaluations

The purpose of the monthly partnering evaluation is to provide a means for all levels of managers on the project to communicate their thoughts, concerns and insights to senior management on a routine basis. Everyone's concerns and opinions are important and need to be heard and acted upon as appropriate.

When completing the evaluation form the response is from the point of view of the person evaluating. For instance, a subcontractor commenting on "budget" would probably respond in the context of the subcontractors budget; however, if he has insight on impacts to the overall project budget, those comments would also be appropriate. The focus and comments can be as broad or narrow as the individual desires.

Written comments are particularly important as they provide senior management more insight as to the specifics of the issue. This is why we ask for comments on ratings of 3 or less. The expectation is Project Managers and Sponsors will look into the issues to assist in their resolution.

Evaluations can be confidential although we recommend they not be so that direct communication can take place with the individual concerned.

Keep in mind that the evaluation is tied to the Charter we developed at the very beginning (first workshop). As honorable people, we committed to act in accordance with the Charter guidelines and work in concert to achieve the charter goals.

UDOT/ Wasatch Constructors
Post Design Services Group
March Partnering Evaluation
(Base responses on your experiences since the last evaluation)
FAX to (801) 594-6813

Name: _____ Date: _____

Company: _____ Tele: _____

Representing: Owner____ Designer____ Contractor____

Evaluation Policy:

• Fax directly to Pat Crooks, Partnering Coordinator, or mail in a sealed internal mail envelope. Name and telephone number are for follow-up purposes only. Confidentiality will be maintained if you do not give your permission to divulge your name. [] **Please check here if you do not want your name divulged to project managers for follow-up purposes.**

NOTE: Comments are required on evaluations rated 3 or less and appreciated on ratings of 4-5 so we can understand your rating.

1. Communication between the Owner, Designer, and Contractor is:

Poor 1 2 3 4 5 Excellent

2. Cooperation between Owner, Designer, and Contractor is:

Poor 1 2 3 4 5 Excellent

3. When issues are raised, the response is:

Slow 1 2 3 4 5 Timely

We are successfully meeting our project goals:

4. SAFETY. Meet the design requirements when executing FDCs for both temporary and permanent construction and in the use of existing facilities.

Not at all 1 2 3 4 5 Absolutely

5. QUALITY. Meet or exceed the I-15 design requirements. Perform post design program that complies with ISO 9001 certification, the DQMP and CQMP.

Not at all 1 2 3 4 5 Absolutely

NAME: _____

(Design Group)

6. SCHEDULE. Deliver FDC packages and submittals to meet construction schedule.

Not at all 1 2 3 4 5 Absolutely

7. BUDGET. Cooperate to maintain a cost efficient process. Provide resources commensurate with schedule and scope being provided.

Not at all 1 2 3 4 5 Absolutely

8. PERFORMANCE. Achieve 100% of award fee for design elements in the quality criteria.

Not at all 1 2 3 4 5 Absolutely

9. TEAMWORK. Have a professionally rewarding experience. Develop a work environment based on respect trust and cooperation. Maximize Owner/Designer/Constructor collaboration for post design solutions. Fair and timely issue resolution. Work together to meet construction segment expectations.

Not at all 1 2 3 4 5 Absolutely

10. Are you using the process to escalate unresolved issues to the next level in a timely manner?

Not at all 1 2 3 4 5 Absolutely

UDOT/ Wasatch Constructors
I-15 Design Group Project
Partnering Evaluation Summary
August 1997

1. Communication between the owner designer and constructor/sub is:

1 = poor

5 = excellent

Results: Owner – Mean:	<u>3.9</u>	Range:	3 – 5
Designer – Mean	<u>4.2</u>	Range:	4 – 5
Constructor/Sub – Mean	<u>4.2</u>	Range:	3 – 5

Comments:

Owner:

- Could be a little better, especially in the area of plan release dates, design changes after release, etc.
- Weekly management meetings provide good communication.

Designer: Office communication is excellent. We need to improve the communication between the field and the offices' / designer.

Constructor/Sub: Still need more talk before letters are sent that cause hard feelings.

2. Cooperation between owner, designer and constructor/sub is:

1 = poor

5 = excellent

Results: Owner – Mean:	<u>4.0</u>	Range:	4 – 4
Designer – Mean:	<u>4.2</u>	Range:	4 – 5
Constructor/Sub – Mean:	<u>4.2</u>	Range:	4 – 5

Comments:

Owner:

- All 3 parties are focused on project goals.
- Very good so far.

Designer, Constructor/Sub: None

3. When issues are raised, the response is:

1 = poor

5 = excellent

Results:	Owner – Mean:	<u>3.9</u>	Range:	3 – 4
	Designer – Mean:	<u>3.8</u>	Range:	3 – 4
	Constructor/Sub – Mean:	<u>4.0</u>	Range:	3 – 5

Comments:

Owner:

- Responses are timely, however improvement is possible.
- Issue regarding owners' ability to verify design progress is being resolved slower than I feel it needs to be.

Designer: Cannot respond as a QA manager. I am not directly involved.

Constructor/Sub: need timely response to issues that arise in the field, especially geotechnical and utilities

We are successfully meeting our project goals:

4. SAFETY. Meet RFP design requirements as supplemented by design criteria requirements for both temporary and permanent construction.

1 = not at all

5 = absolutely

Results:Owner – Mean:	<u>3.5</u>	Range:	3 – 4
Designer – Mean:	<u>4.5</u>	Range:	4 – 5
Constructor/Sub – Mean:	<u>4.6</u>	Range:	4 – 5

Comments:

Owner:

- Some Concern with temporary hot designs (2100 So.).
- Fairly good, but I think the traffic control could be improved somewhat.

Designer:

- I don't know.
- Office is good. Some objects still in aisles but being moved.

Constructor/Sub: None

5. QUALITY. Meet or exceed the design requirements of the RFP and proposal. Obtain design approval for each final package with first submittal. Minimize the need for field design changes. Implement design program that complies with ISO 9001 Certification.

1 = not at all

5 = absolutely

Results:Owner – Mean:	<u>3.9</u>	Range:	3 – 4.5
Designer – Mean:	<u>3.8</u>	Range:	3 – 4
Constructor/Sub – Mean:	<u>4.0</u>	Range:	4 – 4

Comments:

Owner:

- Quality seems good, especially in design. Documentation is a little slow coming.
- Does not appear that all in design are serious about using quality management plan to produce quality design.
- QA audits are positive.

Designer:

- Moving well towards a 5, which I believe we will achieve by project end. ISO cert. moving forward. Increase in communication from field – contractor office – design office will improve our plans and reduce the field design changes.
- Quite a few field design changes.

Contractor/Sub: None

6. SCHEDULE. Target design completion December 31, 1998. Deliver “release for construction” package to meet construction milestones.

1 = not at all

5 = absolutely

Results: Owner – Mean:	<u>3.8</u>	Range:	3 – 5
Designer – Mean:	<u>4.5</u>	Range:	4 – 5
Constructor/Sub – Mean:	<u>4.0</u>	Range:	3 – 5

Comments:

Owner:

- Design schedule appears on target.
- I’m starting to become concerned about meeting defined intermediate milestones.
- In the latest “RFC” schedule I received, it looked like several items were late.

Designer:

- Concern with 1997 wall packages.
- Wall schedule slips.
- Still behind on some items/ packages, but with Wasatch I believe that this will improve. All working on less changes, quicker decisions and less meetings. Will be interesting to see how this progresses. It is the key to success.

Constructor/Sub:

- We still have missed many targeted release dates – but effect on construction not clear yet.
- Some design packages are not meeting schedule, but generally the schedule is being met.
- Several design packages are late.

7. BUDGET. Complete design at or below the target price. Beat target quantities by 5%.

1 = not at all

5 = absolutely

Results: Owner – Mean:	<u>4.0</u>	Range:	3 – 5
Designer – Mean:	<u>4.5</u>	Range:	4 – 5
Constructor/Sub – Mean:	<u>4.0</u>	Range:	3 – 5

Comments:

Owner:

- I have no idea.
- N/A – more applicable to design/contractor.

Designer: No knowledge. Target quantities appear reasonably on target.

Constructor/Sub: Sverdrup/Deleuw progress reports have not been completed – evaluation can't be made.

8. PERFORMANCE. Achieve 100% of award fee for design elements. Quality–Time–Management.

1 = not at all

5 = absolutely

Results:Owner – Mean:	<u>3.4</u>	Range:	2 – 4
Designer – Mean:	<u>4.0</u>	Range:	3 – 5
Constructor/Sub – Mean:	<u>4.2</u>	Range:	4 – 5

Comments:

Owner:

- Schedule issues need to be resolved.
- Award fee not yet resolved.
- DQMP is much improved.

Designer: Can only comment on Q/A of plans process, but here I believe we will get the maximum we can. Very good relationship with I-15 team.

Constructor/Sub: None

9. TEAMWORK. Have professionally rewarding experience. Develop a work environment based on respect, trust and cooperation. Maximize Owner/Designer/Constructor collaboration for design solutions. Fair and timely issue resolution. Work together to meet construction segment expectations.

1 = not at all

5 = absolutely

Results:Owner – Mean:	4.1	Range:	3 – 5
Designer – Mean:	4.2	Range:	3 – 5
Constructor/Sub – Mean:	4.2	Range:	3 – 5

Comments:

Owner:

- This is a rewarding project.
- Everyone is working together well.

Designer: I believe as a team we are really trying. Everyone would probably not agree, but from my point of view there is a lot of effort being put out to make it work. I believe that it will.

Constructor/Sub:

- Now that we have designated discipline engineers at the segment level to interface with design, things are better.
- Not much trust yet.

PARTNERING CHALLENGES AND SOLUTIONS

Diverse Cultures

The diverse culture of each individual organization was one of the problems that partnering had to overcome early on in the project. Some people from within UDOT and Wasatch had a hard time interacting with each other as part of a team instead of as adversaries. Facilitated meetings, the success of the partnering program and, in a few instances, the direct intervention by Tom Warne and/or Al Kirkwood assisted in changing the minds and attitudes of some of the team players.

Memorandum of Understanding for “Better or Equal Substitutions”

A significant challenge occurred early in the partnering process that threatened the success of the project. The issue centered on Wasatch’s use of materials, products, and procedures that were different than those in UDOT’s specifications or what Wasatch had submitted in the original proposal. UDOT’s opinion was that the substitution of these materials, products and procedures constituted a change order and needed to go through the formal change order process, where a change in cost or time or an added value to the state would be the only basis for deciding whether or not a change would be granted. Wasatch’s opinion was that the materials, products and procedures spelled out in the specifications and in their submitted proposal were only a best guess of what to use, based on minimal information and a minimal design effort. When differing conditions than those anticipated arose, the aforementioned documents were not binding and a change order to modify them was required. Wasatch was also concerned about the large amount of time the change order process could take and the significant impact it would have on the project’s schedule.

As the result of a partnering session on January 30, 1998, the first Memorandum of Understanding (MOU) was signed, which permitted the substitution of equal or better products or procedures without a change order, provided the material, method or product to be substituted was as good as or better than the original. **Figure 6-3** is this memorandum.

One person, the UDOT deputy project director, would make the decision, as to whether a product to be used was as good as or better than the original. This, rather than a Change Board Group, was used in order to keep the process rapid. The issue was resolved using a facilitated meeting and the principles of partnering and was a defining moment in the success of the partnering process and the project.

A concept that is important to understand is what is “in the box” and what is not in the flexibility provided by the design/build process. When a Contractor is given a performance specification and a charge to deliver a final product there is much more latitude for the delivery process and even the final product so long as it meets the performance criteria. The MOU resulted in a process that recognized this flexibility and provided a means to still have control over the outcome sufficiently to satisfy UDOT’s requirements.

Issues Needing Outside Experts

At times, significant issues were encountered that required bringing in outside experts. Each party would bring in experts at their own expense to address the issue or if agreed to they would split the cost of bringing in experts between them. The discussion and final resolution of the conflict was determined in a facilitated meeting. A determination was usually made up front to abide by the conclusions of the third party experts.

MEMORANDUM OF UNDERSTANDING
CONTRACT CLARIFICATION
UDOT/WASATCH I-15 RECONSTRUCTION
JANUARY 30, 1998

1. A change to the Proposal that is equal or better in quality does not require a VECP or a change order but will be agreed to and documented by signing the technical agreement form. Approval administratively of technical form agreements through UDOT technical support manager and Wasatch Constructors' design manager to recommendation forwarded to UDOT deputy project manager for approval.
2. Under performance specifications, the design specifications for work will be drafted, discussed, agreed to and documented by signing the technical agreement form. Approval administratively of technical form agreements through UDOT Technical Support Manager and Wasatch Constructors' Design Manager to recommendation forwarded to UDOT Deputy Project Manager for approval. These specifications may contain variations that are equal or better in quality to the corridor/standard specifications and will not require a change order.
3. For design elements that do not have a performance specification, the standard specifications apply and can not be changed without a change order.
4. Requested changes in mandatory requirements not including 1 through 3 above, are subject to change order including VECP when appropriate..

UDOT keeps risk on:

Force Majeure
Directed Scope Changes
Owner Caused Delays
Hazardous Materials
All others specified in the contract not listed above

DSC (differing site conditions) Wasatch will accept the first \$5 million claims in aggregate on DSC. All issues negotiated to an agreed upon final value. Present potential change orders with DSC's will be dropped (600 N geotech, cobbles)

Wasatch accepts sealed document errors subject to Wasatch ability to make specification changes through field design memo for equal or better quality using the process outlined in #1 and #2 above.. This does not include errors and omissions design liability on original design. (Present potential change orders with errors in sealed documents will be dropped)

Wasatch/UDOT share 50/50 cost of delays caused by Railroad & Utilities.

Wasatch accepts responsibility for utility location errors/unknown CP 6.6.6

OCIP issue are not included in the above agreement and remains an open issue.

[Signatures]

Figure 6-3. Memorandum of Understanding

Adhering to Escalation Time Limit Procedures

The agreed time period before escalation to the next level was not always adhered to. It was difficult for people to get over the feeling of failure they felt in escalating a problem to the next level of management, or, in some cases, the fear of looking bad to their superiors. This caused them to hang on to a problem longer than the time limits agreed to in the escalation ladder document. On the other hand, on a few occasions, upper management felt that insufficient time or effort had been invested in solving the problem before it was escalated. On these occasions, the problem was moved back down the ladder for further discussion at the lower level. Once an issue got to the Executive Director level, the decision made was generally based on a business decision. Tom Warne commented during an interview that more explanation by the higher levels on their reasoning in making the decisions would have helped eliminate complaining and aided people in accepting the decisions and moving forward.

Award Fee

The \$50 million Award Fee was an area of contention. From UDOT's point of view the award fee was a reward for work done well and on time, while from the Contractor's point of view it was money in the contract that was theirs and could only be taken away for poor performance or late work. This basic philosophical difference in how the Award Fee was viewed persisted throughout the project.

It was suggested by Wasatch that the Award Fee was counter to the concept of partnering and was a throwback to the "catch and punish" philosophy encountered in typical highway construction. The UDOT Project Director, however, was a strong advocate of the Award Fee. In the end, 99% of the Award Fee was paid out.

While the Award Fee process was used on the I-15 Project there never was complete agreement between the two parties of the contract as to how it was supposed to be used. This continued to cause some friction between the parties that was never completely resolved.

LESSONS LEARNED

Commitment to Partnering

It is essential, especially in the beginning of a project as large as the I-15 Project, that upper management commits to the partnering process and that they invest significant time, training, and coaching at lower levels getting buy-in. For those new to partnering, the inertia of how things have always been done is difficult to overcome. This was especially common in the construction inspection area where the typical concept of "catch, stop work and punish" was replaced with observe, inform, and partner the problem. Because the project schedule was so tight, all conflicts had to be worked out quickly and efficiently, even as the work continued. The commitment of the top managers of both UDOT and Wasatch to partnering was arguably one of the most significant reasons the project was a success.

Internal Partnering Meetings

Participation by UDOT project staff in internal partnering sessions was needed to help them understand the concepts better before engaging in partnering with people outside of their organization. It took about six months of partnering before the various groups pulled together as one cohesive team. Also, moving people into and out of the project was a hardship, since it took a while for the new people to become acquainted and comfortable with the partnering process and the team.

Designer Involvement in Board of Directors (BOD)

Designers were not regularly involved at the BOD level of the project. UDOT felt that designers needed to be more heavily represented on the BOD, especially early in the project. Though other people were invited to the BOD meetings when necessary, it was decided that only one board member would officially represent all of the design disciplines at the BOD meetings.

Escalation Time Limits

The escalation process time limits must be followed closely in order not to slow project progress. Upper management must convince the team that the escalation of a problem is not going to be viewed as a failure, and that individuals have nothing to fear from elevating a problem provided they have made a good faith effort to solve the problem at their level.

Need to Follow the Escalation Process

The importance of not skipping rungs on the escalation ladder must be consistently communicated; otherwise, the formal process will break down and individuals will feel that their prerogative to make decisions at their level has been denied.

Need to Provide Rationale for Decisions Made at Higher Levels

Decisions made at a higher level need to be communicated and explained to the lower levels in order to keep up morale and achieve “buy-in.” This is especially important when the decision is based on business decisions rather than the technical merit of the issue. It would also demonstrate the support and consideration of higher-level management for their personnel.

Partnering Empowerment

The partnering process empowered people to take responsibility and make decisions at the lowest levels possible. People learned to take more reasonable approaches to solving problems in order to prevent their decisions from being overturned at a higher level.

Principle of “Doing the Right Thing”

Partnering helped to focus on doing the right thing. Looking at what is best for the project became the first priority. Next, was looking at the contractual requirements of the issue. This was all done with the schedule and cost constraints in mind, which provided good solutions to issues and kept the project on schedule and under budget.

Frequent Reviews of Charter on Long-Term Projects

The partnering charter must be reviewed periodically and changed as necessary. This should be done at least yearly for the life of a long-term project. This re-chartering not only keeps the document a viable, living guideline, but has the added benefit of reenergizing all of the team members. The refresher partnering session held every six months for a half-day helped to reenergize the team.

Importance of Formalizing the Process

The formal issue resolution process of regularly scheduled meetings worked well because it identified a counterpart, by name, for each project role. Thus each person knew who to go to for the resolution of issues. It also made negotiations easier because they had to spend time with their counterpart getting to know them. These meetings forced people to sit down face to face and discuss the issues.

Emphasizing Professional Interactions

Sometimes the evaluations or issues upset people, because it can be taken as personal criticism by the affected people. However, it needs to be agreed to in the beginning to treat each other with professionalism and courtesy and to employ tact in all communications and dealings. This was not a significant problem on this project but the potential was recognized.

CHAPTER SEVEN: PUBLIC INFORMATION

This chapter describes and evaluates the public information program used during the I-15 Project and analyzes and documents the effectiveness in distributing valuable project information to the surrounding communities and stakeholders.

The I-15 Project utilized innovative techniques and a flexible, dynamic process to inform the public about the project. Some of these were different than the traditional methods used by state DOTs on projects of this type. This chapter documents the results of interviews with project staff and stakeholder groups along the I-15 corridor, highlighting what methods worked well and not so well, and provides a synopsis of the lessons learned about effective public information for a project of this magnitude.

OBJECTIVES AND GOALS

The principal objectives of the public information program were to:

- **Educate the Public on the I-15 Project's Vision.** This was the big picture message that “the pain of reconstruction will be worth the completed product.”
- **Inform the Public on Project Progress.** This involved the celebration of key milestones, such as highway, bridge and interchange openings as they were finished.
- **Provide information to assist the general public in coping with the inconveniences resulting from the project during its construction.** This was the day-to-day information that the public required for trip planning, involving highway, interchange and bridge closures, detours, and suggested alternate routes.

The internal goal of the public information program was to instill public confidence in the I-15 Project process and maintain support for the reconstruction. Public confidence and buy-in allowed UDOT and Wasatch to do their job more effectively and efficiently because the public came to trust UDOT to do a quality job. Through this trust, the I-15 Project could be completed more smoothly and efficiently.

ROLES AND STAFFING

UDOT made a critical decision to hire a public relations consultant (Wilkinson Ferrari) to implement and oversee the public information program for the I-15 Project. The selected consultant had the talent and resources to move forward at the fast pace required by the project. The consultant was required to quickly handle the enormous workload necessary to execute the public information program.

Initially, UDOT and Wasatch designated responsibilities *by public information program tasks*. Early on, this proved not to be an effective structure and this approach was changed. The revised structure divided the responsibility for dissemination of information between UDOT and Wasatch *by type of information* instead of by task. Responsibilities were divided into vision and progress information (UDOT) and coping information (Wasatch). This structure and the division of work between UDOT and the Wasatch public information staffs proved to be very effective. It took time for everyone to get comfortable with their respective roles, relationships to develop, and trust to evolve and be established between the two

public information teams. By working together, a unified public information team evolved with distinct responsibilities for each team member.

Throughout the course of the public information program, there were approximately three to four public information staff on the agency (UDOT) side and four to five public information staff from Wasatch. It was easier for Wasatch to perform some tasks, such as distributing fliers throughout the corridor, because they could mobilize more staff resources quickly.

TECHNIQUES

The UDOT Public Information Manager estimated that 75% to 80% of the public information effort was accomplished “behind the scenes.” These were the daily activities that took place internally, such as planning and strategizing, that ultimately resulted in the visible and tangible public information effort.

The public information team on the I-15 Project utilized both traditional and non-traditional methods in implementing the public information plan. These traditional and non-traditional techniques and strategies were combined to keep the public informed of the I-15 reconstruction closures and detours so that the traveling public could adjust schedules and routes. These techniques also kept the public focused on the I-15 Project’s vision and progress.

The I-15 public information team identified the stakeholders who were to receive project information throughout the project. Some communication techniques worked better than others for specific stakeholders. Some of the techniques gave the public information team the opportunity to be more responsive to the public and tailor the public information plan accordingly.

Below are some of the primary methods and techniques used in the public information plan. It is not an exhaustive list of methods and techniques used, but presents some of the more prominent examples.

Traditional Techniques

Some of the more traditional techniques used on the public information plan included a project newsletter, broadcast faxes, printed maps, a Web site, press releases, highway advisory radio (HAR), roadway signing and variable message signing (VMS), project tours, and print and electronic communications.

Project Materials. The public information team produced collateral materials, including a quarterly project newsletter, general information maps, and brochures for general distribution and at meetings and special events. For example, the rental car agencies at the Salt Lake City Airport were provided maps with construction closures and detours to give to visitors. Detour and closure maps were distributed to businesses to share with their vendors, employees, and customers. These were very effective ways to get project information to the public.

The most effective printed material was the “Friday Fax.” Each Friday, the public information team sent a fax to hundreds of recipients that highlighted the upcoming closures and suggested detours, as well as recent openings. At the peak as many as 1,000 faxes were sent per week and Wasatch engages a fax service because of the magnitude of the effort. This information was beneficial for commuters and businesses to share with their employees. All parties – both stakeholders and staff – expressed the usefulness of the Friday Fax. However, it was noted that over time and as more of the project was completed, the value of the Friday Fax decreased.

Signing. Various signing methods were used. Temporary signs were created for businesses to emphasize “business as usual” and direct customers and vendors to businesses. Variable message signs (VMS), electronic signs that are easy to change and provide real-time information, were similarly used. Wasatch used portable message signs early in the project and then installed permanent variable message signs that became part of the finished project. Early on, when the project was criticized for inadequate signing and public opinion surveys confirmed the magnitude of the concern, the public information team and Wasatch made some changes in signing to better address business and commuter needs.

Media. The media was used strategically to give information to the public in a timely manner. The mass media, such as newspapers, published general information. Paid print ads in newspapers highlighted closures and detours. Press conferences were held for major issues and to celebrate openings and successes. Television coverage also assisted in giving information to the public about the project through news coverage and limited advertising and public service announcements.

Press releases were sent out regularly, and meetings with the editorial boards of the major publications were held. The public information team negotiated with a radio group that owned several local radio stations and bought the ten-second radio tags following the traffic reports. This “tactical radio” was very successful in getting timely information to commuters.

As a result of the media approach on the I-15 Project, UDOT transformed their internal agency media policy. UDOT public information staff is now more comfortable with the media and reporters and are more proactive in meeting with editorial boards. In fact, some believe the project received a lot of favorable, unsolicited coverage from the press as a result of the I-15 public information program.

Meetings. Many different types of meetings and gatherings were used to get the word out. Meetings structured to be productive and meaningful so people would obtain useful information.

A community Task Force of about 125 participants was established early in the project. The Task Force met once a month for breakfast. Early in the project, this group proved to be a great feedback mechanism to UDOT. After awhile, participation dwindled as other means of communication became more useful and effective.

I-15 public information persons and other staff attended neighborhood and professional organization meetings. The first year of the project required a “presentation circuit” and a presentation manager to accommodate all the requests for presentations. Many I-15 staff outside of the immediate top-level and public information staff was trained to make presentations on the I-15 reconstruction.

Updates on the project were a standing agenda item at the monthly Council of Government (COG) meetings. The public information team and other top-level staff gave regular project updates to the state legislature and mayors. Tours and field trips of the corridor were also made available to the media, politicians, and other stakeholders.

Other Electronic Communications. Some forms of electronic communications were more effective than others in reaching the general public. A Highway Advisory Radio (HAR) was in place, but was not effective and never really caught on. The project Web site (www.I-15.com) provided information on closures and details, as well as other project information, but Web site usage only increased towards the end of the project, as more and more people gained access to the Internet.

A project hotline was available to the public, but was not accessed very much. It was difficult to have a staff person dedicated to receive all incoming calls to the hotline. The Public Information Manager believed other techniques were more efficient in accomplishing the public information goals.

Other Techniques. Celebrations for the openings on sections of the highway, new bridges and interchanges were top priority. These successes were commemorated by cookouts with the local community, parades, and other celebratory events. The events usually involved the adjacent communities and were attended by top-level staff. The event emphasized the progress messages for the I-15 Project.

Non-Traditional Techniques

The public information team used some strategies and techniques not common to UDOT and its public information process. These non-traditional approaches assisted in more effectively getting the word out about the I-15 Project and helped to keep project news “new.” The actual structure of the public information team and division of responsibilities – vision and progress (UDOT) and coping (Wasatch) – was unique, and included the following tasks.

Research. Research was the foundation of the public information plan and drove the public information program. The public information team identified many of the stakeholders early in the public information process. They recognized that each stakeholder group had different information requirements and that not each group needed to receive the project information by the same method. UDOT hired a local public opinion polling firm to work on the I-15 Project. The research effort and pollster’s work continued throughout the project and became the backbone of the public information program.

Focus groups were held with stakeholders early on to help create the vision for the project. Focus groups also assisted with the identification of what types of information stakeholders wanted to know, how often they wanted or needed to have this information, and in what format it should be provided. The focus groups were instrumental in identifying the preferred modes of communication and timing.

One-on-one interviews were held with the media before the project began to assess if reporters and editors would find the I-15 Project newsworthy and if reporting interest could be sustained. The public information team found that the media was eager for new, interesting, and timely project information. The more the media knew about the scope of the project, the better the reporting. One-on-one interviews were also conducted with the state legislators on the Transportation Committee.

What really drove the public involvement program was the public opinion survey that was conducted every six months. This telephone survey polled commuters, businesses, and the general public about the I-15 Project. UDOT project and management staff felt the surveys were well worth the investment.

The survey results illustrated what the public knew about the project, what they wanted to know, and where people received their information. It allowed the public information team to tailor the outreach efforts and change the plan in response to survey results. According to survey results, UDOT’s public approval ratings rose consistently throughout the project. The surveys served as a reality check and balance mechanism for the public information team. For example, the survey indicated that in the first phases of construction, the signing in the construction corridor was not very effective. Based on this feedback, the public information team directed Wasatch to create a better signage plan.

Messaging. Integral to the public information plan was that all of the I-15 Project team members – not just the public information staff – were communicating the same messages about the project. This consistency of staying “on message” really assisted the I-15 Project team in conveying accurate and timely project information that kept the public and the media educated about the project

The public information team developed key messages and shared them weekly with UDOT’s top-level management and other I-15 team members. In response to a crisis or incident, the public information team formulated messages so all team members could convey the same information to the media and public. This helped prevent any misinformation or rumors from being started.

Partnering. Also unique to the public information program was the partnering effort between the UDOT and Wasatch public information staff members. The public information staff members were required to participate in partnering sessions to build a more cohesive team. Partnering helped the staff outline the team goals and objectives, understand roles, and recognize the different cultures between UDOT and the design-build team. The staff members could then be respectful of the different environments of UDOT and Wasatch.

An “Issues Manager” was available to help resolve any conflicts within the various disciplines. For example, if the public information team were having difficulty resolving an issue, they quickly elevated the conflict to the Issues Manager who assisted in seeking a solution. Staff came to recognize that elevating a problem to the Issues Manager was not a failure, but actually a means to resolve a simple difference of opinion.

WHAT WORKED

Interviews revealed that once the direction of the public information plan was specifically focused (through the research) on the two key objectives of educating the public about the project and providing information on coping with impacts during construction, the plan was very successful in its execution.

The key element stated by both public information staff and stakeholders is that UDOT provided the information that was needed and wanted in a timely manner. The research indicated that the public wanted to be educated about the project – they wanted no surprises. Specifically, they wanted to know what they should expect of the project, how it would affect their lives, when, and for how long.

Also of key importance was the identification and dedication of a public information team whose responsibility was to be accessible and responsive to the communities and the interest groups along the corridor. This team was specifically trained for this function and was able to raise issues with appropriate top-level UDOT and Wasatch management.

Prior to the creation of the team that eventually executed the public information plan; the public information program was significantly less responsive and less able to respond to local concerns. This was mostly due in part to the shift from a lead/supporting approach for UDOT/Wasatch, respectively, to the ultimate approach of dividing responsibility between vision and coping information.

Implementation of the plan provided information in a timely manner. The accessible and responsive public information team proved to be very important when there were local issues and concerns about either the information distributed or in-the-field construction activities.

The project message and vision enabled the public to see value in the I-15 investment, be supportive of it, and be willing to accommodate the inconveniences of construction. As a result, the December 2000 research indicated ratings for both UDOT and Wasatch of over 70% favorable. This rating is unusually high for a public agency or public project, and reflects the high level of “external” trust that developed between the public and UDOT through the public information plan process. It also reflects the high level of “internal” trust that had developed between UDOT and Wasatch and consultants.

As stated by UDOT and Wasatch staff, “This approach is valuable and absolutely essential to the success of this project,” and UDOT stated they would not start another without a similar public information plan in place.”

Key Successful Components

Five basic components of the plan have been emphasized by both public information staff and recipients as being an essential component to the attainment of this high level of internal and external trust:

Interest and involvement of top-level staff at UDOT and Wasatch with the mayors and state legislators.

This resulted in a high level of listening and hearing what would be needed to inform the public and to provide necessary information to cope with the project. The visibility of top-level management from both UDOT and Wasatch was symbolically important externally, providing the sense that UDOT and Wasatch did care and that local elected officials were communicating with UDOT and Wasatch about local concerns.

Internally, this involvement resulted in a very close partnering relationship between UDOT and Wasatch, with each taking roles in new areas and giving up traditional project responsibilities. For example, the creation of an overall project Issues Manager assisted in elevating critical issues to the highest levels in UDOT and Wasatch for joint resolution. This ensured that the public information plan was an integral part of the project decision-making process and that processes were structured to ensure timely response to issues and distribution of focused project information to the public.

Unique public information team structure in which clearly assigned roles and responsibilities in communicating with the public were defined. Organizationally, UDOT communicated directly with state legislators and mayors via regularly scheduled, area-wide transportation planning group meetings (e.g., the Wasatch Front Regional Council, the regional Municipal Planning Organization (MPO)). UDOT also communicated with the public, focusing its message on overall project information and progress reporting of project milestone events (openings and closings). This information was communicated via a designated UDOT project spokesperson, primarily through the media.

Wasatch met directly with businesses, property owners and residential groups to proactively inform them of the details of the project schedule and upcoming construction traffic modifications (street closures, detours). Wasatch also provided information on maintaining local access for owners and clients (signing, maps, and timing of activities) in order that those affected could best cope with the upcoming effects of construction. Public communications were coordinated via a designated project spokesperson for Wasatch.

This clear assignment of roles resulted in clarity and consistency in the message presented to the public. It also instilled confidence and trust in the public of the ability of the I-15 Project team to hear and understand local issues and to be responsive to them.

Use of research to identify public issues and shape timely agency response. Early on, twelve focus groups of individuals and groups along the corridor indicated various misconceptions about the project and the scale of its effects. Based on these findings, the direction of the public information plan and the role of the participants in the plan were substantially changed to that which proved to be successful. It was critical for top-level project staff to observe the working of the focus groups. It allowed them to witness the real reaction and emotion that was representative of the public's emotion.

General drivers and business decision makers were surveyed semi-annually. The survey was used to assess the level of public confidence in UDOT and Wasatch, determine the public's feeling of being adequately informed of the project, and evaluate the use and effectiveness of communications regarding the project. The results of each survey were comparatively evaluated, and subsequent public information activities were planned and conducted in response to the research information. This research enabled UDOT and Wasatch to tailor the information and process of delivery to the public to address the most critical issues in a timely manner.

Extensive use of the media in "getting the word out." The public information plan remained dynamic and flexible in responding to the variety and changing nature of the public's concerns about the project. The plan also was flexible in utilizing a wide variety of techniques for communicating information to the public so that the project retained its newsworthiness – and remained "new news."

The project messages and processes for getting the word out were continually changed. Many techniques were utilized, including print and electronic media, television, hotline and HAR in-car radio, Web site and e-mail, Friday Fax, project newsletters, flyers/mass mailings, brochures, presentations, business fairs and seminars, community task forces, public meetings, and on-site activities.

The most consistently successful and influential technique was the use of print and electronic media. Specifically, this included public service announcements, project-focused articles and stories, and radio and television messaging. Interestingly, one of the most effective techniques was the ten-second radio tag to traffic reports. The increased use of paid media provided greater control of lead-time scheduling and the accuracy and content of information provided. The research indicated the high level of success these methods of communications had.

Delivery on commitments. The plan was very successful in "doing what it said it was going to do," particularly with planned closings and openings and providing workable alternatives during construction. Related to this was that there was minimal lag-time between an announcement and the ensuing activity. The public was able to see work happening and early-on visible progress. This greatly enhanced the believability of the message from UDOT and Wasatch.

WHAT DIDN'T WORK

Although the public information plan was largely successful, there were four problems that should be addressed in future public information programs.

Key Problem Areas

Commencing the public information plan without identification of project issues through research. Clearly, the success of the I-15 public information plan was the tailoring of the plan to the specific issues and concerns along the corridor. Neither the initial request for proposal (RFP) for the public information

plan nor the initial public information plan was based on research of specific project issues. Not surprisingly, focus groups held early on indicated that UDOT was not being responsive to local concerns and that there was significant public misconception about the project and the scale of its impacts.

After identification of these issues, the direction of the public information plan altered significantly. Comment was received that in order to receive more responsive proposals, RFPs should be based upon identified project issues, and the findings of that research should be made available to proposers.

Although the focus groups played a significant role in reshaping the public information plan early on, there were some subsequent instances where the information from the groups was not heeded, with disastrous results. For example, an ill-fated “Satch” television ad campaign. The character of Satch was created as a way to convey project information and to encourage people to accept the inconveniences. The focus groups clearly stated that they didn’t believe the, “just live with it/mellow out” message would be accepted. The campaign was initiated anyway, and was soon withdrawn because of lack of positive public response. Although not damaging to the overall public acceptance of project information, it did take valuable resources from other more appropriate efforts.

Lack of clarity in defining the relationship of the I-15 Project to other construction projects. It was indicated that it was sometimes not clear that other roadway construction in the area was not part of the I-15 Project, causing confusion regarding the project message that was being sent to the public.

Specifically, if one community responded to the particular effects of the reconstruction with its own program of local improvements, it was not always clear to other communities that those improvements were not part of the I-15 Project. Therefore, there was some concern about, “Why can’t we have that, as well?” An example was the reaction to locally constructed street improvements in the city of Sandy by citizens in South Salt Lake. The public information plan did not seem to adequately address the relationship of these other projects to the I-15 Project.

Trouble getting information to the public outside of the project reconstruction area. There was a feeling that not enough information reached people outside of the Salt Lake City area. For example, tourists and potential skiers to the area had the impression that the entire Salt Lake Valley was “torn up.” The visitors’ centers, tourism board, AAA, and the resorts could have used the I-15 Project information in their own information programs.

Difficulty in reaching impacted businesses. A better job could have been done in getting information to impacted businesses earlier in the project. Recognizing that it is a challenge to get business people to attend meetings, it unfortunately becomes a crisis for the business when the detour cones appear and construction is imminent or has begun. Walking the corridor and directly giving the information to each affected business was necessary.

LESSONS LEARNED

Throughout the evaluation and interview process, specific items repeatedly emerged as valuable lessons about public relations and public information. These Lessons Learned are provided below in an effort to highlight recommendations based on the I-15 public information program that can be used by other state governments and agencies considering similar projects.

Cultivate the commitment of top-level people to good public information and demonstrate personal commitment to the project. The commitment of top-level staff allows for resources to be available for a flexible and dynamic approach to dealing with the public. A message delivered by top-level agency management carries significant weight with the public. These people do not have to attend every presentation or meeting about the project, but should make a concerted effort to be available and actively participate in the project. Early public outreach efforts conducted by top-level staff demonstrate their commitment to the project.

Assemble a public information team that can listen, respond, and be accessible. The ability to have the “right” people to listen, respond and be accessible is highly appreciated by the project stakeholders. A well integrated, competent, and talented team is also essential to ensure a responsive public information program.

Maintain a flexible and dynamic planning process. It is important to keep pace with the methods by which people get their information and the changes in perceptions about the progress of the project. What may have worked best at the beginning of a project may not work well later in the program.

Rely on the research. An effective method for keeping current with stakeholder needs is to conduct research and rely on it. Use research to identify issues and shape responses. The public information RFP should be developed after initial research has been completed. Success of a public information plan will rely heavily on the ability to address specific issues and concerns along the corridor. A good public information plan cannot be standard – rather it must be tailored to the unique aspects and issues on each project.

Present a clear and consistent message. For each member of the project team, identify a role and the “message” they are responsible for delivering. In some cases, roles may be assigned based on talents and capabilities. Roles and goals may also be assigned to the agency or organization with ultimate responsibility for that aspect of the project. No matter what the role or media, the message should be consistent.

Seek a high level of internal trust within the project team. The project team should seek to develop a close working relationship that crosses the border between the agency and contractor. The identification of a specific Project Information Manager, with direct access to the top-level project management, can be a key to the success of any public information effort, because it allows an immediate response and collaboration on project issues.

Recognize the public’s fear of the “unknown” aspects of a project. By addressing uncertainty, the public can be educated about transportation projects in general and the project specifically.

Employ staff with the skill set for public information/relations. It is important to have staff that are experts or have been trained in public relations serve in this capacity. Not everyone is a public involvement specialist or good public speaker. Hiring a professional public relations/information consultant should be considered. UDOT chose to hire an outside consultant because it lacked the in-house resources to accomplish the mission of the public information program for I-15.

Use paid and free media to your advantage. It has been worth the cost of paid media to ensure that a message was correct, accurate, and consistent. The use of free media can supplement paid media efforts and provide comprehensive coverage of the project.

Utilize a variety of media techniques to keep the news “new.” It is important to stay current with changing technologies and methods for delivering project messages. Media techniques that may have worked well or been important sources of information at the beginning of a project may not be used as frequently by the public mid-way through the project. The project team should use a variety of techniques to keep up with new methods of communicating information.

Show visible progress on the job site. Although this may not appear to be a direct public information method, progress on the job site represents a commitment by the agency to completing the project. Activity translates into tax dollars being used wisely. This can gain substantial credibility for the agency and the contractor. Also, if a commitment is made, fulfill it.

Conclusion

In conclusion, it is recommended that an agency embarking on a large construction project, which requires extensive public information, should consider hiring a professional public relations consultant to execute the public information program and oversee the contractor’s public information efforts. The RFP to select the public information consultant should not be released until adequate research (including surveys, focus groups and one-on-ones) is conducted to reflect public concerns, issues and methods of preferred communications. It is recommended that public information be divided between progress and vision information (the agency) and coping information (the contractor). By requiring the agency and contractor public information staff to work together and be cognizant of the research, the public information plan can be a fluid and dynamic program that addresses and responds to the public’s needs and concerns.

The high level of external trust between the public and UDOT and the high level of internal trust between UDOT and its contractors and consultants is integral to the success of the I-15 Public Information Program